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THE IMPERIAL COLLEGE OF TROPICAL AGRICULTURE, TRINIDAD, B.W.I.

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SIR DANIEL MORRIS, K.C.M.G.

THE death of Sir Daniel Morris to which we referred briefly in our last issue, closes the career of a very prominent figure in the history and development of tropical agriculture in our Colonial Empire. His name, however, will chiefly be associated with the West Indies where he did so much during his life to promote agricultural industries and allied organisations.

Beginning his career in Ceylon in 1877 as Assistant to Dr. Twaites of the Royal Botanic Gardens, Peradeniya, Morris was promoted in 1879 to the Directorship of Public Gardens and Plantations, Jamaica. During his seven years' tenure of office there he visited British Honduras in 1882, and St. Helena in the following year, when he contributed a valuable report on the economic possibilities and resources of the latter. His paper on "Planting Enterprises in the West Indies" published in 1883 attracted so much attention that it was subsequently presented to Parliament. At this time* there were very few botanic institutions devoted to botanical work in the West Indies and Morris was among the first to suggest that botanic stations should be established in all the West Indian Colonies. As the outcome of his general proposals on this matter, addressed to the Governors of the West Indian Islands in 1885, no fewer than six botanic stations were established and one botanic garden revived (St. Vincent) between 1886 and 1891. In addition, an experiment station was established at Dodds, Barbados (where research work on sugar-cane had already been started), and a chemical laboratory in Antigua. Although these various developments took place when Morris was Assistant Director at Kew (1886-1898) he was constantly in touch with the work and actually returned in 1890, on a special mission, to stimulate and aid it. An account of this mission appears in the Kew Bulletin.†

There is no doubt that this period marked a definite advance towards the development of scientific agriculture in the West Indies. Not only were the new botanical stations closely associated with Kew, which was largely responsible for the movement, but they also paved the way for the formation of experimental stations and later, of agricultural departments.

In 1893 Morris was made a C.M.G. "in recognition of scientific and economic services rendered to Her Majesty's Colonies". In 1895 he visited the

* Watts, F., Tropical Department of Agriculture, with special reference to the West Indies. *Journal Royal Society of Arts*, Vol. LXVIII, Nos. 3509 and 3510, 1920.

† 1891, pp. 103 to 168.

Bahamas. In 1896 the general economic conditions of the West Indies were so alarming, particularly in regard to the sugar industry, that they called for the appointment of a West Indian Royal Commission. The report of this Commission of which Morris was expert adviser on agricultural and botanical questions, marks another important phase in the history of West Indian agriculture. It led to the creation of the Imperial Department of Agriculture and to the return of Morris as first Commissioner of Agriculture for the West Indies.

The Imperial Department was inaugurated in 1898. With the help of an Imperial grant amounting to some £17,500 a year, headquarters were established at Barbados and a staff of experts on various branches of science was enlisted to teach and advise in the Leeward and Windward Islands. In planning the work of the Department, Morris wisely built on the existing organisations, such as the botanic stations, which he had helped to evolve, and on such others as he thought might have a likely bearing on agricultural development. The work of each of these organisations was carefully explored and, where it was found promising and useful, assisted and extended, with the help of grants-in-aid. Thus, out of ill-equipped and somewhat nondescript institutions, definite local departments of agriculture were formed in most of the islands, particularly in the smaller ones, while the work of the departments of agriculture of the larger Colonies was consolidated under the fostering care of the Imperial Department. From this development, scientific activity in relation to agriculture was increased and many botanical, mycological and entomological problems were studied with particular attention to local crops. Amongst the many achievements of the Department during that period must be mentioned the improvement of sugar-cane by hybridisation, the introduction, through Morris himself, of Sea Island cotton, and the extension of the cultivation of limes, cacao, arrowroot and many other tropical products.

The need for bringing the results of the scientific work of the Imperial Department to the notice of the general public was never lost sight of by Morris. For this purpose he organised annual agricultural conferences which were attended not only by scientific representatives from all the islands but also by representatives from agricultural societies and education departments. By this means he was able to bring home to the scientific worker the needs of the practical agriculturist and to inspire the practical man with confidence in his scientific advisers. Knowledge gained from the investigations of the Department was further disseminated through the *West Indian Bulletin*, a quarterly scientific Journal, the *Agricultural News*, a popular fortnightly review, and by pamphlets on special subjects, of which fifty-four were issued during Morris' regime. Agricultural education also received attention from the first; grants were made for instruction in agricultural science in several schools, and lecture courses on the theory and practice of agriculture were arranged for primary school teachers, overseers and small proprietors.

The work of the Department, successfully launched, Morris turned his attention to numerous other problems which were at the time affecting the welfare of West Indian agriculture. In particular, he sought to improve the trade relations between Canada and the West Indies, an object which he achieved by organising, in 1908, the Canadian Reciprocity Conference. This was followed by the Dominion appointing a special Trade Commissioner.

In 1903 Morris was knighted and in 1908 he retired, after ten years service, from the Imperial Department which he had so ably directed. His period of retirement does not appear, however, to have been an idle one as he served as Scientific Adviser in tropical agriculture to the Colonial Office until 1913, and as a member of the Governing Bodies of the Imperial Institutes of Mycology and Entomology and of the John Innes Horticultural Institution of which he was Vice-President.

Much of Morris' success was due to his remarkable knowledge and administrative qualities and to his exceptional ability as a writer and lecturer. The *Times* pays him a fitting tribute by saying that "his work in the West Indies certainly qualified him for a niche in the Empire's Temple of Honour and it is by that work in particular that he will be gratefully remembered in the annals of the British Empire".

The future of the West Indies was a source of great anxiety when Morris came in 1898 but when he left, ten years later, there was encouraging evidence everywhere of progress and security. This was due, in the greater part, to the unremitting efforts of the Imperial Department. Its policy was ably continued by Morris' successor, the late Sir Francis Watts, who carried developments still further by establishing the central sugar factory system and the West Indian College of Agriculture, as it was first called. Thus, the Imperial College of Tropical Agriculture, the various Departments of Agriculture in the West Indies and the new Advisory Department of the College have all originated through the activities of Morris and Watts. These institutions have grown considerably in scope since the retirement of these two men but this does not alter the fact that they have traditions to maintain. The problems by which agriculture in the West Indies is confronted at the present time afford ample opportunities for carrying on the good work so well begun.

AGRICULTURAL NOTE BOOK.

Copies of Professor Wood's "Note-Book of Tropical Agriculture" (price 5 shillings) may be obtained on application to the Editor, *Tropical Agriculture*, Imperial College of Tropical Agriculture, Trinidad, B.W.I.

THE FLOOD FALLOWING OF CANE FIELDS IN BRITISH GUIANA.

By R. R. Follett-Smith.
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During the present century, it has been an increasingly popular practice in British Guiana to flood-fallow any cane-fields which may be suffering from a temporary lack of fertility. Before describing the methods used for flood-fallowing, a short explanation must be given of the general lay-out of a sugar estate in British Guiana. The coast lands of the colony lie below the level of the sea at high tide. The process of empoldering consists in constructing dams to surround the estate. The sea-dam, at the front of the estate, and lying parallel to the coast, protects the estate from inundation by sea-water. The sea-dam has now been replaced by a permanent sea-wall. The back-dam usually lies parallel to the sea-dam, and is situated at the extreme inland limit of cultivation. Its function is to protect the estate from flooding by fresh-water from the savannahs which lie behind the estate. In some parts of the colony, water is conserved in these wet savannahs, and furnishes a supply of irrigation water to the estates. The sides of the estate are protected by dams joining the extremities of the sea-dam and back-dam. A further dam, known as the "middle walk," divides the estate in halves. This dam forms the chief line of communication between the sea-wall and the back-dam. In order to construct these earthen dams, trenches have to be dug on either side of them; those on the inside of the side-lines usually serve as drainage channels, while those on either side of the middle walk are used for navigation purposes. At intervals, smaller trenches are dug at right angles from the navigation trenches, and these divide the estate into rectangular fields. These trenches form a means of access to fields, and permit the passage of large punts for the transport of canes. These trenches also provide a means for irrigating the fields when necessary. The fields are divided into beds, usually about 35 feet in width. If the beds run parallel to the middle walk, they are called 'Dutch beds'; if at right angles to the middle walk, the fields are known as 'English.' The beds are separated from each other by open ditches which are inter-connected by "four-foots" or "cross trackers" respectively; the drainage water discharges from these to the side-line. The side-lines have ultimate access to the sea through a sluice.

The present methods of flood-fallowing may be described as follows. The drain-mouth of the field is closed by earthen "stop-offs," and irrigation water is pumped into the fields from the navigation canal by means of irrigation pumps housed in punts. The whole field is submerged and left in this condition for periods varying from three months to two years. The water lost by seepage and evaporation is replaced by further occasional pumpings. When the field is to be brought into cultivation, the water is allowed to run off, and the field is left to dry. The weed mass is cut, and the usual planting operations are carried out. The resulting increases in crop are very marked in the plant-canes, but gradually disappear with succeeding ratoon crops. The origin of flood fallowing is obscure, but the practice was probably initiated as the result of endeavours to combat insect pests (notably the large moth-borer (*Castnia licus*). Harrison refers to the practice in a paper in the *West Indian Bulletin* (Vol. XIII, page 123), in the following words:

> "It has been noticed, probably first very many years ago by bygone races of planters, that land long under cultivation, and apparently in a state of temporary agricultural exhaustion, if flooded with water and left in that state for some months or even a year or two, where the water was drained off and the land replanted, sugar-canes grew on it with great vigour, and gave a succession of heavy crops. This practice has been steadily becoming more in vogue since 1894, when the Hon. R. G. Duncan employed it more or less successfully on Pln. Windsor Forest as a means of combating rind and root diseases of sugar-cane. It is difficult to fully explain its action."
>
> "It is very probable that the vast quantities of water, frequently purely rain-water, used for flooding the fields, take up from the lower layers of the soil and the upper parts of the subsoil large quantities of the injuriously concentrated soil waters, thus lessening the degree of alkalinity of the clays and reducing the proportion of sodium and magnesium salts which are present in the parts of the soil which form the support of plants."

The method had been previously used in Surinam, and, in its early stages, the submergence depended entirely upon fortuitous rainfall. With the introduction of portable irrigation pumps in about the year 1912, it was realised that complete submergence produced the best results. The system was generally applied to the heavy clay soils of the sugar-cane belt. It was found difficult to keep the water on the lighter and more porous pegasse soils, unless special clay dams were provided. The practice is entirely empirical, and forms a good example (of which there are many in the annals of agricultural research) of the evolution of a very effective method of cultivation which has defied scientific explanation for a considerable period of time. The optimum depth of flooding water, and the best period of submergence, are subjects of much discussion. Brown water, typical of the swampy tropics, is usually employed; it contains, on the average, 16 parts per million of mineral solids. Apart from Harrison's suggestion that large quantities of toxic salts are removed from the soil, no explanation of the mechanism of the action has been forthcoming, although numerous suggestions, backed by little

or no experimental evidence, have been put forward. Harrison's suggestion does not furnish a full explanation, since flood fallowing is effective on estates of the Demerara West Bank and West Coast areas where the salinity of the soil and subsoil is low. It has been suggested that the acidity of the characteristic creek waters used for flooding is responsible for a marked reduction in the alkalinity of the subsoil. It has been calculated by Crabtree (*Rept. Agric. Conditions of the Sugar-Cane Industry in British Guiana*, 1921) that a foot-depth of these waters contains the equivalent of 27 lb. of sulphuric acid per acre. Such a concentration of acid is unlikely to effect materially the reaction of a heavy clay. The nitrogen content of these waters (4 lb. per acre foot) may be considered negligible. A further suggestion is that the varied aquatic flora and fauna which thrive during the period of inundation, and are subsequently incorporated with the soil, increase its organic matter content. This is obviously not a major factor, for ordinary fallowing produces a heavier weed cover, but does not give rise to the decided benefits which accrue from submergence. Other possible subsidiary factors may be enumerated; weeds that compete with cane growth are eradicated; fungoid and insect pests are destroyed. It is possible that, during submergence, a partial sterilisation of the soil takes place, and that protozoa, fungi and other micro-organisms are reduced in number, with the consequence that the number of soil bacteria is greatly increased when the field is again brought into cultivation. Such an explanation does not account for the prolonged effects of flooding which persist for two or three years, for it is probable that the population of micro-organisms will become normal in a much shorter time.

It is noted by the planters in regard to the flooding phenomenon :—

(1) That there is an improvement in soil texture.
(2) That flooded soil assumes a reddish tinge.
(3) That the greater the depth of flooding water the more pronounced is the effect upon subsequent cane-growth.
(4) That a more marked response is obtained from fields further aback.

During the past year a certain amount of work upon this problem has been carried on in the laboratory of the Department of Agriculture.

The results suggest :—

(*a*) That the improvement in texture is partly due to the interaction of the flooding water, containing small amounts of lime, with the sodium-clay subsoil.
(*b*) That the ammonia content of the soil is increased.
(*c*) That considerable amounts of soluble salts are removed from the soil.

These effects will be considered in detail.

(*a*) *Improvement of Texture on Flooding.*—A recent paper by Mackenzie Taylor and Woodman (1) described attempts to find a cheap field method for permanently improving the texture of sodium-clays. They noted that, if a sodium-clay was shaken with dilute lime-water, the soil settled rapidly, indicating a considerable improvement in texture. It was found that, once the soil has been settled by treatment with lime-water, the latter could be replaced by pure water for a considerable number of times before the improvement in soil texture disappeared. The authors further noted that, if the original soil were shaken with lime-water (0.091%CaO), flocculation occurred, and that the lime-water could be indefinitely replaced by a more dilute lime-water (0.0091%CaO) without impairing the improved texture produced by the first treatment.

Preliminary experiments were carried out with a few representative British Guiana soils, with a view to deciding the minimum concentration of lime-water which would produce these effects. It was found that, if the soils were first shaken with lime-water (0.027% CaO), flocculation took place in 24 hours. Half the clear supernatant liquid was then carefully withdrawn from each soil and replaced by more dilute lime-water (0.0027%CaO) at succeeding 24 hour periods. The appearance of the suspension was noted at each interval; the results obtained are presented in Table I.

TABLE I.

Soil.	Exchangeable Soda mgm. equivs. per 100 gr.	No. of Replacements by dilute lime-water.								
		1.	2.	3.	4.	5.	6.	7.	8.	9.
D256	0.68	N.F.	N.F.							
B 31	1.90	N.F.	N.F.							
D257	2.73	F.	F.	F.	F.	F.	F.	F.	F.	F.
D261	3.71	N.F.	N.F.							
B 32	4.32	F.	F.	F.	F.	F.	F.	F.	F.	F.
B 30	4.94	F.	F.	F.	F.	F.	F.	F.	F.	F.
B 30	5.92	F.	F.	F.	F.	F.	F.	F.	F.	F.

N.F. denotes not flocculated.
F. denotes flocculated.

The results have been duplicated; in general they indicate the improvement in texture brought about by treatment of soils containing appreciable amounts of exchangeable soda with dilute lime-water. No explanation of the anomalous behaviour of soil No. D261 is, at present, forthcoming. These effects, however, do not entirely explain the improvement in texture consequent upon flood-fallowing, for this improvement is noted throughout the cane-lands of the colony, yet the soils of the West Coast of Demerara contain little exchangeable soda.

The reddish colour of submerged soils may be due to the presence of films of ferric oxide where originally ferrous iron was present. The work

(1) *Journal of the Society of Chemical Industry*, 12th June, 1931.

of W. H. Harrison and S. Aiyer in India with swamp padi soils, indicated that the presence of a film of algae on the surface of the soil accounted for the production of oxygen from the carbon dioxide evolved, and that this oxygen brought about the oxidation changes noted. A similar explanation may perhaps apply in the case of flood-fallowing.

(*b*) *The Effects of Flooding on the Ammonia Content of the Soil.*—Subramanyan, working with Indian and Rothamsted soils, noticed that the ammonia content of soil increased during submergence with water. He attributed the phenomenon to the presence of a deaminase which attacked simple amino compounds with the production of ammonia. Measurements of the increase in ammonia content of British Guiana cane-soils due to submergence were made in the laboratory. Four quantities of 25 gms. of each soil were weighed out into beakers and flooded by the addition of 40 cc. of distilled water. The ammonia content of two of the samples were immediately determined, while the ammonia content of the other two samples was measured after seven days submergence. The results obtained are preserved in Table II.

The mean increase of ammonia, stated as nitrogen, is 16.8 parts per million, which corresponds to a dressing of about 2.5 cwts. of sulphate of ammonia

TABLE II.

Content of Ammonia-Nitrogen (parts per million of soil).			Reaction (pH value).		Organic Matter Content (per cent).	Carbon/Nitrogen Ratio (C/N).
Before Submergence.	After 7 days Submergence.	Increase in Ammonia.	Normal.	Exchange.		
42.0 p.p.m.	89.6 p.p.m.	47.6	5.60	4.43	1.67	5.5
33.6	77.6	44.0	4.15	3.85	7.70	13.6
41.6	70.4	28.8	5.12	3.82	1.35	6.1
12.8	32.0	19.2	4.6	3.7	4.45	10.7
81.6	97.6	16.0	4.43	3.78	1.57	6.4
21.6	33.6	12.0	5.42	4.00	1.14	6.7
14.0	25.3	11.3	4.55	3.73	3.04	10.7
17.6	26.4	8.8	4.90	4.10	1.41	5.0
8.0	15.2	7.2	5.5	4.3	1.64	8.2
8.0	15.1	7.1	4.70	3.83	1.29	6.4
28.8	34.4	5.6	4.68	3.80	5.11	14.5
21.6	27.2	5.6	6.0	4.9	2.16	7.0
19.6	23.6	4.0	5.9	4.6	2.92	7.1

Mean increase, 16.8 p.p.m. of ammonia nitrogen.

TABLE III.

Increases in Ammonia Content as Nitrogen.—(parts per million of soil.)

Soil No.	Increase.	Final pH	Increase.	Final pH	Increase.	Final pH	Increase.	Final pH
D 430 ..	8.8	4.9	30.4	7.0	39.2	8.6	—	—
D 400 ..	7.1	4.7	9.6	6.4	24.2	7.1	—	—
D 402 ..	16.0	4.4	17.6	5.9	20.0	6.6	20.8	6.7
D 507 ..	11.3	4.6	14.7	6.0	18.8	8.5	19.2	7.2
DCPXXXVI ..	19.2	4.6	16.2	6.4	16.3	7.2	—	—
D 501 ..	5.6	4.7	8.0	6.1	11.6	6.7	—	—

per acre foot of soil. Since the changes depend upon the effect of an enzyme, it was thought that the reaction pH value of the medium, or the amount or nature of the substrate (organic matter), might influence the magnitude of the increase. It will be seen that there is little connection between the amount or nature of the substrate (as defined by its carbon-nitrogen ratio), and the production of ammonia. There appears to be no relation between the soil reaction and the increase in ammonia content.

A few of the soils were next treated with pulverised limestone in order to vary the reaction of the soil-water mixtures. Appropriate blanks were also examined in each case. The results obtained are given in Table III, where the figures are the result of closely-agreeing duplicates.

It will be seen that, with the exception of soil DCPXXXVI an increase in the production of ammonia during seven days submergence is obtained when the soil receives an application of limestone. The addition of organic matter of wide carbon-nitrogen ratio (50.5) previous to flooding tended to diminish the production of ammonia. (Table IV.)

TABLE IV.

Soil.	Increase in Ammonia Content (Nitrogen), (p.p.m.)
D 400 alone	15.1
D 400 *plus* 0.25 gm. rice straw ..	14.7

It would be of interest therefore further to examine the effect of the incorporation of organic matter of *narrow* carbon-nitrogen ratio. Experiments with differing periods of submergence, indicated that no definite increase in ammonia content occurs beyond a period of seven days. In Subramanyan's experiments, the maximum production of ammonia was reached in a similar period.

The optimum dressing of sulphate of ammonia for cane is being investigated by means of field experiments upon flooded and unflooded land. The plant-cane results of experiments so far undertaken by the Department of Agriculture, indicate that, on *unflooded lands*, from 4 cwts. to 6 cwts. per acre of sulphate of ammonia forms the best application. On *flooded lands*, the nitrogen requirements appear to be lower. A dressing of 2 cwts. per acre of sulphate of ammonia gave as good a plant-cane yield as one of 4 cwts. per acre, and was superior to a dressing of 6 cwts. per acre. These field results confirm the laboratory work, and suggest that the nitrogen supply of *flooded lands* is superior to that of *unflooded lands*. A further point of interest is that, with a second ratoon crop on *flooded lands*, the nitrogen requirements of the cane were best satisfied by a dressing of 4 cwts. to 6 cwts. per acre of sulphate of ammonia. The inference to be drawn from these experiments is that flood-fallowing increases the ammonia supply to the plant-canes, but that the effect disappears in the second ratoon crop.

(*c*) *The Removal of Soluble Salts by Flooding.*—In certain areas of the cane-lands of British Guiana, there is an accumulation of soluble salts in the soil and the immediate subsoil. These salts consist mainly of the chlorides and sulphates of sodium and magnesium, and at times occur in quantities capable of adversely affecting cane-growth. Some evidence, indicating the quantity of soluble salts removed by flooding, has been obtained. Five samples of flooding water were collected and examined for certain of their constituents with the following results (Table V), stated as tons per acre, assuming that the weight of water on the beds and in the drains of one acre is 840 tons.

TABLE V.

Tons per Acre.

Samples.	A.	B.	C.	D.	E.
Bicarbonate (HCO_3)	2.56	3.42	4.10	—	—
Lime (CaO) ..	0.84	0.62	0.97	0.37	1.11
Magnesia (MgO) ..	1.45	1.29	1.29	0.37	1.28
Sulphate (SO_3) ..	2.09	0.79	0.94	—	—
Chloride (Cl)	2.77	2.10	2.18	—	—
Soda (Na_2O) ..	2.12	1.95	1.94	1.01	0.66
Potash (K_2O) ..	—	—	—	0.32	0.03

Samples A, B and C were obtained from fields flooded originally with creek-water which, on the average, contains mineral matter equivalent to 1.3 tons per acre. Samples D and E were from fields submerged by an accumulation of rain. It should be noted that the average lime content of these five waters is 0.0009% CaO. This figure is considerably below the minimum content of lime found necessary for flocculation in the laboratory. It is possible that the lime originally present in the water has been absorbed by the soil.

Discussion.

It is apparent that the three factors above described do not furnish a complete explanation of the mechanism of flood-fallowing. Marked improvement in soil texture is noted in areas where no sodium clays are present, and striking crop increases are obtained on land where soil salinity is absent. It seems likely that other potent factors are concerned in the marked improvement of soil texture. Investigations on the nature and amount of exchangeable bases

present before and after flooding are projected. The significance of the reddish tinge of flooded soil has yet to be gauged. In this connection, measurements of oxidation-reduction potentials might prove instructive.

In some areas, beneficial effects are produced when pegasse soils are submerged with water containing final molasses at the rate of 5 tons per acre. The pegasse soils of the colony are highly unsaturated, by bases such as calcium, and usually contain quantities of 'exchangeable' alumina. They are, as a rule, deficient in potash. Such soils probably absorb the bases present, becoming less unsaturated and improving in texture. It is known that dressings of potassic manures are beneficial to crops suffering from aluminum toxicity. The treatment of pegasse soils by flooding with dilute molasses, which contains appreciable amounts of potash, may alleviate, to some extent, the effects of aluminum toxicity.

Field experimentation on flood-fallowing is beset with difficulties, and, since each individual plot requires its own bunds or smouses, the lay-out is expensive. The Empire Marketing Board has recently devoted funds to sugar research in this colony, and part of this grant will be spent on experiments on flood-fallowing. The following points of practical importance will be investigated; (*a*) The optimum period of submergence. (*b*) The effect of small dressings of limestone prior to flooding. (*c*) The optimum depth of flooding water. (*d*) The effect of increasing the aquatic flora. (*e*) The effect of additions of molasses to the flooding water.

Summary.

A system of soil renovation, peculiar to the cane-lands of British Guiana, is described. The method consists in the total submergence of cane-fields under water for periods varying from three months to two years. The mechanism of the phenomenon is obscure, but suggestions, in explanation, supported by a certain amount of experimental evidence, are tentatively submitted. In some areas, certain toxic salts are flushed out of the soil. Subsoils containing exchangeable soda may experience improvement in texture due to flooding with dilute solutions of lime. The ammonia content of the soil increases upon submergence. The major effect (*i.e.*, a marked improvement in soil texture) has so far not been adequately explained. The effect may be due to oxidation processes, or to some change in the nature and amount of exchangeable bases present in the soil. Field experiments, designed to answer points of practical importance, are projected.

THE MANUFACTURE OF COCONUT FIBRE.

[*The following notes are abstracted from a typescript memorandum entitled "Coir or Coconut Fibre: A Report on its Extraction and Manufacture" by S. G. Barker,* Ph.D., F.R.S.E.]

Maturity of the Nut at Harvesting.

In most cases the main object in coconut cultivation is the production of copra. The tendency therefore is to gather the nuts when they are entirely ripe, as then the greatest quantity and best quality of coconut oil is most easily produced. The question of the maturity of the nut best suited for the extraction of coir fibre has given rise to considerable controversy, and opinion is divided as to whether the nuts should be harvested before they are fully ripe. On the other hand it is claimed that by methods of chemical retting the ripeness of the nut and the time of storage are immaterial. Excellent results have been obtained with nuts gathered in Ceylon and India and stored for as long as six months after being transported to England.

Soaking.

After the nuts have been split open the white "meat" is removed and dried to form copra, and the fibrous husk is soaked in order to separate the fibres, many varied methods of "retting" being employed. By the older methods the husks are soaked in backwaters or lagoons, the sites being carefully selected by trial and error methods, since it was observed that certain conditions of soil and water produce the right colour and quality of fibre. In the modern Philippine factories, the husks are soaked in concrete tanks in fresh water for only two or three days, after which they are subjected to mechanical decorticating or combing, which is usually repeated four times. The fibre is then washed by brushing in fresh water, sun-dried, combed again, and sorted.

Fowler and Marsden investigated the factors concerned in retting, and concluded that the brown colour of the water, on first setting to soak, is due to the tannin-matter extracted, and that a blue-black colour in this water and subsequent dulling of the fibres is due to the presence of ferruginous water brought down by inland floods, tannate of iron being formed. They also suggest that the cork or pith of the husk is not itself the binding material, but that it is associated with a gum, mucilage, or hemicellulose, which is insoluble in water and can be resolved by the action of bacteria, by treatment with water under pressure, or by chemical agents.

Whatever the method of soaking, the husks must remain under water until complete separation is possible, eight months being about the minimum necessary with salt water to obtain the best coloured fibre. With fresh water soaking, the outer skin decomposes in about seven months and cannot be removed easily, so that the husks should be removed after about six months. It

has been found that the period of soaking can be shortened by crushing the husks before soaking, in a simple mill similar to sugar-cane crushers. After soaking for one month these husks may be removed, crushed again, and resoaked, the time of retting being considerably reduced by this method.

Chemical and Mechanical Methods for Quick Retting.

Three methods are prominent: the Nanji process; the Van der Jagt process; and the "H.G." process. All three are different in principle, but for all the husks should be split or crushed as much as possible, a factor which may not be economic except upon a large scale. The Nanji process consists in the treatment of partially crushed green or dry husks with lime, sodium sulphate, or sodium carbonate containing a trace of aluminium sulphate, at a steam pressure of 80 to 100 lb. per square inch, for a period of one to two hours. On such treatment the intracellular pithy substance is completely loosened from the fibre and may be removed by washing.

In the Van der Jagt process, mature nuts may be used, and thus copra may be produced in the same factory. The raw husks are fed on to a conveyor and opened in a husk-preparing machine. A second conveyor takes the opened husks to a boiler in which revolves an endless chain equipped with paddles, carrying the husks round with it in a boiling dilute solution of caustic soda. After boiling for the requisite time the soft husks are conveyed to a machine which disintegrates and squeezes thoroughly, the expressed liquor being used again for boiling fresh husks. After cleaning and softening, the fibre is dried mechanically and spun on machinery similar to that used for jute.

In the "H.G." process the nut is extracted and the husk removed in one operation, effected by a single machine, the husk sections being compressed or rolled to remove excess of moisture. After washing in hot water the crude material is immersed for about four hours in a solution of water and ionised H.G. oil of pH 7 maintained at 200°F. The ionised oil not only facilitates the splitting up and separation of the fibre and adhering matter, but has the effect of being absorbed. The fibre is thus softened to an extent which enables it to be spun and woven on machinery of the jute type. Fibre extracted by other methods may be softened by immersion in the ionised oil, and in this way made suitable for fine spinning.

After separation, the coir is sorted into the various market gradings by a combing process. Roughly a threefold commercial classification is made :—

(1) "Mat Fibre."—This is the finest quality and is spun into yarns for the manufacture of ropes, twines and mattings.

(2) "Bristle Fibre."—A coarser and thicker quality employed in the manufacture of brushes and brooms.

(3) "Curled Fibre."—A short variety, used for padding mattresses or upholstery, as a substitute for horsehair.

It has been estimated that the pithy and cork-like matter constitutes as much as 70 per cent. of the husk. Suggestions have been made that this material could be used as a mulch, to aid in relieving the difficulty in obtaining organic manures in the tropics. When the nitrogen, phosphoric acid, and potash contents of a sample of coir dust are compared with those of a sample of cattle manure, it is found that coir dust contains about half as much nitrogen and potash and one-seventh as much phosphoric acid.

The Uses of Coir and its By-Products.

From time immemorial coir has been used for matting, brushes, ropes and cord. Its elasticity and resistance to decay make it an excellent material for these purposes, but the older methods of preparation have limited the uses, as the fibre so obtained was brittle, and dark in colour, with low tensile strength. The improved methods of preparation have resulted in the production of material of lighter colour which is soft enough to be spun and woven on jute machinery. This has opened up a new field of uses, particularly for sacks, carpets and rugs. As a protective material for underground pipes and cables the experimental stage has now been passed. The high resistance to decay by water or bacterial action, added to the fact that impregnation with tar or bitumen is easy, make coir very suitable for this purpose, and the increased pliability renders it possible to cover pipes of narrow bore with good contact all round.

Research into the uses of coir has received a strong fillip from the chemical methods of preparation, and rapid developments are probable.

D. W. D.

BOOKS RECEIVED.

The following have all been presented by Professor Ballou to whom our thanks are due :—

Imperial Department of Agriculture for the West Indies. From the *West Indian Bulletin*, 1911.

West Indies. Report on the Working of the Imperial Department of Agriculture for the West Indies.

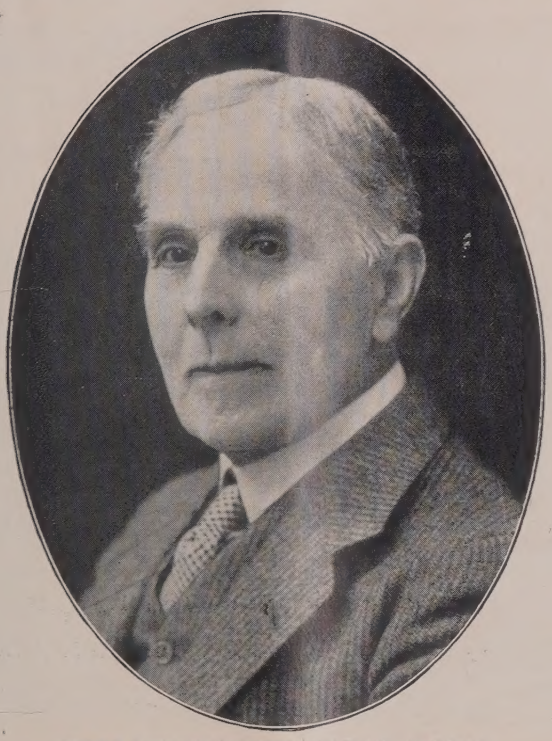
Identity of the Fibres Agaves by L. H. Dewey.

The Opisthobranchiate Mollusca of the Branner-Agassiz Expedition to Brazil by F. M. MacFarland, 1909.

Illustrations of the Indigenous Fodder Grasses of the Plains of North-Western India. Vol. II.

Fourth Conf. Inter de Genetique by Ph. de Vilmorin Paris, 1911.

Tables for Biometricians by K. Pearson.



THE LATE SIR DANIEL MORRIS, K.C.M.G.

IMPERIAL COLLEGE OF TROPICAL AGRICULTURE.

Photo by *G. A. Gibberd.*

This photograph which was taken from the chimney top of the Sugar Factory, shows the Milner Hostel (extreme left), the Main Building, the Biological Laboratory and the Banana Plots.

CACAO BEANS AND *EPHESTIA ELUTELLA*.

By Raymond V. Wadsworth.

Introduction.

Considerable attention is being paid at present to the problem of the insect infestation of stored products. One of the chief pests studied in this connection in temperate regions is the moth *Ephestia elutella* which constitutes a menace not only to the cacao bean but also to many other types of stored products. In the following paper the life and habits of this pest, especially in relation to the cacao bean, are recorded in the hope that they may throw some useful suggestions towards its control.

Life History.

Ephestia elutella, a small grey moth, and a weak flier, lays its eggs singly, or in twos or threes, generally attached by a weak gummy solution, in small crevices—a crack in a wall, a fold or seam of a bag, or a crack in the shell of a bean. Occasionally it lays them loosely on the floor or on any available surface. These eggs hatch into minute larvae which wander off in search of food but as their need for sustenance is not immediate they may spend a day or two in search of a suitable feeding ground. Thus, the exact place of the egg-laying is of secondary importance. The larva can enter any hole or crack which is not less than $\frac{7}{100}$ inch at its narrowest point, the limit to the size of the hole being its head size, as this is of unyielding chitin, whilst its body is soft and pliable and can be pulled through an even smaller hole. During its preliminary search for food the larva has apparently two objects, firstly, to seek a sheltered spot where it can live undisturbed, and, secondly, to find food which is sufficiently soft for its newly hatched and tender condition. The latter is important, for although the nib of the bean is not too hard to be attacked, the shell of the fermented bean will be shown to be too hard for this attack. Having found suitable food, it will settle down in some sheltered spot for its larval life period.

The amount of food consumed during the larval stage is variable but on the average amounts to 0.3 to 0.6 grms. It takes two or three larvae to consume the whole of the nib of an average cacao bean. The larva's diet is very varied. Hardly any foodstuffs come amiss—dried vegetables, flour or biscuits, dried fruits, &c., are all suitable. Its food even consists of other dead insects, including its own parents. It has been bred throughout its life history on dead *Tortrix viridana* which shows that even in an empty store many will survive unless there is absolute cleanliness.

The larva's subsequent pupation and its emergence as a moth need not be detailed, though there are many interesting points in these periods of its life history.

Types of Beans attacked by *E. elutella*.

Variety.

As a result of the examination of many lots of infected beans, and also of experimental work, it has been found that the nib of the Criollo bean (*i.e.*, beans with a light red-brown nib and generally softish in texture), is more readily attacked than the nib of the Forastero bean (*i.e.*, beans with the purple and hard type of nib). The more open texture of Criollo cacao and its comparative softness, together with, probably, the slightly higher sugar content due to short fermentation, perhaps make this type of cacao more liable to insect attack. Moreover its brittle shell is, through cracking, more likely to provide access to the cotyledons. Thus the old finer grades of Ceylon, Venezuela and Samoa cacaos will keep poorly in an insect-infected warehouse.

Unfermented Cacao.

Generally speaking, unfermented beans have a soft shell with some adhering pulp; such a shell can be attacked by the newly-hatched larva. Beans of this character provide little seclusion as the cotyledons are close, but the larva is not starved as it can subsist handsomely on the pulpy shell and in the absence of shelter makes the best of it. In the case of a bad attack by *E. elutella* it sometimes happens that the unfermented beans will be completely denuded of their shells, whilst the cotyledons are only slightly attacked on the surface. *E. elutella* seldom bores a hole for itself into the body of the bean, but just channels the surface on which it lives. This feeding on the shell is an interesting variation in the method of life of the larva. Under normal conditions it settles down in one place and spins a silken tube in which it lives and from which it can easily reach all the food it will need. In the case of a larva feeding on shell, the food is obviously not very congenial and the larva moves a lot. The silk is consequently not so noticeable, seldom being formed into a tube. It may take the shell of three or four beans to provide the food for one larva.

Guayaquil cacao always contains a large percentage of beans of this type and parcels from time to time show the damage characteristic to unfermented cacao. Experimental confirmation of this has been obtained. A bag of beans containing a percentage of unfermented cacao was infected with *E. elutella* and after the breeding of two generations the bag was examined. All the unfermented beans had their shells almost completely removed, whilst none of the fermented beans had been attacked.

Machala and Grenada cacaos exposed under similar conditions showed that in no case had the Grenada cacao shell been affected, whilst the

Machala beans had 49 per cent. with their shells attacked. 30 per cent. showed attack on the shell alone, and 19 per cent. some attack also on the nib.

This point is further illustrated in subsequent tables.

Unfermented beans having close cotyledons, between which a larva cannot crawl, are never attacked internally, like fermented cacao.

Washed unfermented beans differ considerably in that the washing removes the soft pulp and leaves a much harder shell. The attack by *E. elutella* is found to decrease with the degree of washing.

Broken, Cracked and Germinated Beans.

Except in the case of Guayaquil cacao, unfermented beans are met with only in poor quality cacaos. As a general rule this type of defect is disappearing and so does not vitally concern most growers. Many cacao parcels do, however, contain germinated and broken beans or beans with cracked or cut shells, and it is these that constitute the most serious cause of insect trouble. In a general way it might be laid down as a rule that the proportion of such beans represents the maximum infestation a sample may attain.

It has already been stated that the newly-hatched larva of *E. elutella* searches for easily available food and that it cannot attack hard surfaces. The shell of a normal fermented cacao bean provides such a surface, and the only hope of obtaining the food inside is through the finding of a crack or hole. To test this a small sack holding about one pound of beans was placed in a closed space infested with moths. The moths laid eggs and in time a second generation was produced. The infection was a bad one as plenty of moths were used to provide eggs for the preliminary attack. The beans were examined individually and divided into those showing original cracks or holes in the shell and good whole beans in which no such cracks could be observed. The different types were then individually cut open to determine the extent of infection in each. The results were as follows:—

Table I.

	Beans with Crack or Hole in Shell.	*Beans without Crack or Hole in Shell.*
Insects attacked	84%	2%
Unattacked	16%	98%

Possibly even more striking results were obtained in the case of different lots of beans subjected to long storage in precisely the same conditions. Two experiments were carried out, the separate lots in each being kept under one cover, but divided by card partitions and arranged in a circle so that each had the same chance of infection. The infestation was carried out by the introduction of moths in the usual way. The breeding was allowed to continue undisturbed for nearly two years. In the case of Experiment I (Table II) so much food was available that even after two years it was still full of insects at different stages, but mostly in the larval form. In Experiment II (Table III) practically no living insects were left, one or two larvae alone being found during the examination. One experiment was therefore carried on so long as all available food was consumed and the insects died of starvation, whilst the other showed an infection in its heyday.

In Experiment I Accra nib was also included. Being very easily attacked, it contained a large number of larvae, and by the time the experiment was concluded 45.5 per cent. of it had been completely consumed. The inclusion of nib shows how readily available beans are in this form. The roasting of beans cracks a large proportion of the shells and the small percentage attacked is due to the large amount of food available.

Machala beans stand out in having a high percentage of beans showing no visible crack in the shell, attacked. All these beans were soft-shelled beans and the attack was confined to the shell.

Table II.

Beans Attacked by *E. Elutella* under Conditions of Plenty.

Type of Cacao.	Beans with Visible Crack in Shell.	Beans with no Visible Crack in Shell.	Shells showing Visible Cracks.		Shells showing no Visible Cracks.	
			Attacked.	Not attacked.	Attacked.	Not attacked.
	%	%	%	%	%	%
Raw Grenada	4	96	76	24	·5	99.5
Raw Bahia	18	82	92	8	Nil.	100.0
Raw Accra	20	80	90	10	3	97
Raw Machala	16.5	83.5	90	10	12	88
Roasted Accra	47	53	58	42	5.5	94.5

Table III.

BEANS ATTACKED BY *E. Elutella* SHOWING THE LIMITS OF AVAILABLE FOOD SUPPLY.

Type of Cacao.	Beans with Visible Crack in Shell.	Beans with no Visible Crack in Shell.	Shells showing Visible Cracks.		Shells showing no Visible Cracks.	
			Attacked.	Not attacked.	Attacked.	Not attacked.
	%	%	%	%	%	%
Raw Accra	37	63	93	7	Nil.	100
Raw Accra	23	77	94	6	2	98
Mouldy Accra	37	63	100	Nil.	Nil.	100
Germinated Accra ..	100	—	100	Nil.	—	—
Raw Machala	32	68	100	Nil.	6	94
Average	45.8	54.2	97.4	2.6	1.6	98.4

The high percentage of unattacked beans in the Grenada sample with cracked shell is interesting and is due to the fact that these shells, though cracked, fitted tightly over the cotyledons and so did not readily provide shelter for the larvae which sought the more easily available food present.

In Experiment II the percentage of cracked beans was very high throughout. By the end of the experiment, however, practically no life was present, and it will be seen that this occurred only when the cracked beans had been consumed. The few cases where cracked beans were not consumed were instances where the shells fitted very tightly over the cotyledons, preventing the access of the larva. There were still plenty of beans, but the food was protected by the shell and in a land of plenty the larvae died for want of the strength to get the food. Every germinated and cracked bean was completely consumed, so that the shell was the only thing left to represent the bean--its inside being full of frass. The Machala cacao was a sample of well-fermented beans for that class, with only a few soft-shelled beans. It will be noted that these were attacked, though they naturally showed no crack in their soft shells.

Amongst wharfingers in England who store cacao for brokers, sometimes over many years, there is a belief that old cacao is immune from insect attack. Practical experience has shown them that some old parcels of cacao do not breed moths. This is quite in accordance with the results which are given above as the small quantities of available food in parcels of beans containing few cracked or broken beans would, in a badly infected store, be quickly consumed. When once these had been eaten, no other food being available, the parcel would remain immune from further attack.

Position of Sack and Moth Emergence.

At times it happens that the infestation of a parcel of cacao beans seems much greater than that suggested by the moths or larvae seen in the store. When this occurs it will be found that the sacks are stacked on end one or two high only. A sack of beans is never filled absolutely full, as otherwise the bags would not stack well on their side and the chance of bursting during rough handling would be great. This means that a sack on end has at the top a fairly large free space. When the larvae enter this they sense that here is sufficient space for the future moth to fly and meet a mate. They, therefore, do not wander much further, but, finding a suitable space for pupation, spin up. As this occurs inside the sack, the cocoons are never seen. The moths hatch inside the bag and find sufficient space for flying and mating. The next generation is thus produced hidden from view and the store appears comparatively free from insects owing to only a few larvae forcing their way out of the sacks. Moths which hatch inside the sacks cannot get out into the store since at this stage the insects are too frail to force an exit. It is at the larval stage only that this occurs. There is a belief amongst some that the moth does force its way outside the sacks and this was tested, with the following results. Small sacks, made of the usual sack material, three-quarter filled with beans, were placed on end (so as to induce the moths to pupate inside the sack), whilst some were placed on their sides leaving no free space in the sacks, and infected. All these moths were removed from the test as soon as they were dead. After two generations had been fully completed, it was found that every moth in the free space outside the sacks had come from a pupa outside the sacks, whilst the moths inside the sacks had lived and died in their prison, and a pupa for each was inside the sack. Thus moths inside or outside the sacks had hatched from pupae in their respective areas and the insect, as the fully hatched moth, could not move out of the sack in which it hatched. Sacks placed on end constitute a hidden danger to a store, and all sacks should be placed on their sides, when the beans fill all the free space.

Method of Attack.

The method of attack of *E. elutella* will now be quite clear. The moths lay their eggs in the neighbourhood of the beans, generally on the outside of the sack or in its folds. The young larvae hatching must wander for a little time before settling down. During this period the aim of the larva is to find some suitable food which,

whilst being soft enough to attack, also provides some shelter, in which it will remain hidden. In the case of the cacao bean, it finds a crack or hole in a loose shell and crawls into the space between the two cotyledons. Here it lies in the midst of plenty, hidden from view and well protected, and until fully fed when it will have consumed about half a normal bean. Generally, by that time, the hole through which it entered is too small for the grown larva to get out by, and so it eats the shell away in the form of a circular hole and escapes to pupate. If the sack is on end the free space in the sack induces pupation, which frequently may take place there. With normal stacking the larva forces its way through the holes of the sack into the open air, when it soon finds a suitable place to pupate and the life cycle commences again.

Conclusion.

It has been shown that the cacao bean properly fermented and with its shell intact is proof against the attack of *E. elutella*.

The damage caused by this insect is due to the presence of defective beans in the parcel—partially cracked, germinated and broken beans. Cut and unfermented beans are a further source of infection.

Buyers of cacao beans may take as a guide to the maximum possible infection the amount of such types present in any parcel of beans.

Criollo beans are more susceptible to attack than Forastero beans under the same conditions.

Unfermented beans are attacked externally, the soft shell being removed by the larvae.

Sacks stacked on end with a free space at the top of the sacks encourage larvae to spin up inside the sack and so breed hidden from sight. This does not occur with sacks stacked on their sides.

Practical Application.

BEANS.

The defects in the cacao bean which have been shown to encourage the infection with *E. elutella* are also defects which the manufacturers dislike for other causes. Mostly they are defects which have to be guarded against on the plantation. The classes of beans which should be reduced to a minimum are here arranged in relation to *Ephestia* attack, the least important being given first :—

Unfermented beans.
Cut beans.
Cracked beans.
Germinated beans.
Broken beans.

Unfermented beans are generally a sign of inferior preparation and should be fairly easy to guard against.

Cut beans may be caused when :—

(1) Opening the pod.
(2) Turning during fermentation and drying.

Cracked beans are caused by rough handling after drying. Over-fermentation and washing of beans are to be guarded against as prolific sources of this defect. Unnecessary walking over the beans should be discouraged on this account.

Germinated beans are due to poor picking, leaving too long before fermenting or imperfect fermentation.

Broken beans should be separated from the cacao before bagging. They represent the most serious defect. The less the planter is able to produce of these, the less risk there is of cracked beans also being present in the bulk.

Buyers and brokers should consider these defects, particularly the last one, as a guide to the keeping qualities of any parcels offered to them.

STACKING.

The position of the sack does, to some extent, affect the infection of the beans. It has been shown that the correct position of a sack is on its side, when no free space is available to induce the larvae to pupate inside the sack. This position will prevent the hidden breeding of *E. elutella* and enable a storekeeper to see better what infection is present.

STORES.

The diet of *E. elutella* is very varied and it has been shown how the moth may continue to breed on most unlikely material, such as other dead insects. Absolute cleanliness is, therefore, advisable in every store. Regular brushing and whitewashing of walls and roof should be carried out and the more inaccessible the spot, the greater the care which should be taken in cleaning.

Acknowledgment.

The work was carried out in the Research Laboratory of Messrs. Cadbury Brothers, and I wish to express my thanks to the firm for permission to publish the results.

VITAMIN D IN CACAO BEANS.

A sample of raw well-fermented Accra cacao beans taken from a commercial consignment was recently analysed for its Vitamin D. content. It was prepared as follows :—

One hundredweight of beans were submitted to a cleaning operation to remove any extraneous material and were then 'kibbled', this operation consisting in a breaking down of the beans so that the cacao nib can be separated from the husk or shell. The cacao nibs, which include the radicle or the 'germ' were ground first to a rough powder on fluted rolls and then to a fine powder on water-cooled porcelain rolls. The sample for vitamin assay, therefore, consisted of cacao bean, with shell removed, ground to a fine powder, care being taken to prevent any heating during grinding.

Dr. K. H. Coward, of the Pharmacological Laboratories, Messrs. Cadbury Ltd., reported the Vitamin D. potency of the sample as one unit of anti rachitic activity per gram of cacao bean powder.—(*Journ. of the Soc. of Chem. Ind.*, 2nd, Dec. 1932, p. 1008.)

NUTRITION IN RELATION TO REPRODUCTION.

A Summary of Technical Communication No. 2, published by the Imperial Bureau of Animal Nutrition.

STERILITY is a problem of primary importance wherever intensive dairy farming is practised, and it has been proved to be the largest single cause of disposal of animals. Breeding difficulties exist in all classes of stock, but the problem of sterility is less acute in other classes of farm stock than in dairy herds. The causes of sterility may be dealt with under two main heads, infective and nutritional.

Infections in relation to Sterility.

Contagious abortion:—This disease is very widespread and appears to be increasing rather than decreasing, although it is difficult to make a true estimate of its importance as a cause of sterility. The initial losses of calf and milk are so great that there is a tendency to dispose of the animal almost immediately, but it is not definite that a cow which aborts once will become sterile or will abort repeatedly.

Other Infections:—Other conditions of infectious origin regarded as causes of sterility are endometritis and vaginitis. It is suggested that sterility may accompany vaginitis because of the existence in such conditions of "spermatoxins" and "spermalysins". Endometritis has been thought to act in the same way, or to have a more direct action by preventing implantation of the ovum.

There appears to be good ground for the view that diet affects susceptibility to infection. Williams has pointed out that the organs of the non-pregnant cow contain many bacteria which are usually harmless, but which assume a pathogenic role under unfavourable conditions, such as improper feeding. Deficiency of vitamin A alters the condition of the mucous membranes of the respiratory passages, and of the defence mechanisms of the body, while a rickets-producing diet (deficient in vitamin D) fed to rats, which are normally immune to tuberculosis, causes them to become highly susceptible to this disease.

Malnutrition in relation to Sterility.

Fertility depends in the first place on the simple quantitative adequacy of the diet. Famine and war sterility or diminished fertility is known in all classes of farm animals and in human beings. Following the Great War, sterility was common in cattle, sheep and goats in Germany and Hungary, and under-feeding is well known as a cause of sterility in range herds and in sheep on poor pastures. On the other hand, over-feeding is also known to be detrimental to optimal breeding performance. "Show condition" in cattle and "high condition" in sheep for flock competitions, are associated with low fertility or failure to breed.

Mineral deficiencies:—Naturally occurring deficiencies of mineral elements have been shown to affect fertility. Of these possibly the most important is deficiency of phosphorus, since it is of widespread occurrence in natural pastures throughout the world. Many research workers have found that feeding a phosphate supplement, such as bone meal, improved fertility, and the cause has been attributed to infrequency of ovulation on a phosphate-deficient diet. Calcium deficiency effects have also been investigated under experimental conditions, and it has been shown repeatedly that calcium is essential for reproduction. Under natural conditions, however, the point has not been demonstrated clearly, as on lime-deficient pastures the issue was complicated by the fact that general under-nutrition was prevalent.

In areas where endemic goitre occurs, breeding difficulties in domestic animals are frequent, and several experiments have demonstrated that administration of iodine has a beneficial effect on fertility in such cases. It has also been suggested that, under systems of intensive feeding, conditions of relative iodine deficiency might arise in areas where deficiency of iodine is not thought to occur. The results of a four-year experiment at the Rowett Institute suggest that in stall-fed cows there may be a relative deficiency of iodine adversely affecting reproduction.

Vitamin deficiency:—The vitamin most clearly connected with reproduction is vitamin E. This vitamin is fat-soluble and occurs in nature chiefly in green vegetables, notably lettuce, and in the embryos of certain cereals, especially wheat. It is found in milk and egg-yolk, and is present in muscle, fat, placenta, and to a less extent in intestine and liver. It does not occur in plant oils and is apparently absent from cod-liver oil, kidney, brain and testis. In experiments with rats it was found that a diet free from vitamin E does not affect the first litter, but as a depletion of the reserves proceeds, a characteristic condition with death and absorption of the foetus results. Our knowledge of this vitamin is complicated by a recent discovery that a deficiency of vitamin A also causes complete sterility, and that this effect is more rapidly produced than that of vitamin E deficiency. Lack of other vitamins may also cause reproductive troubles, but it is probable that these effects are secondary, caused by the detrimental effect on the general health of the animal.

These results have been obtained under the strictest laboratory control, but it is by no means certain that deficiency of vitamins affecting fertility occurs under natural conditions, as experiments designed to investigate the point have yielded inconclusive results.

D. W. D.

REVIEWS.

Chromosomes and Plant-Breeding.

By C. D. Darlington, Ph.D., D.Sc. *Macmillan & Co., Ltd.*, London, 1932. pp. 105 and Index, price 7*s*. 6*d*.

Dr. Darlington tells us in a prefatory note that his book is based on a series of articles that appeared in the *Gardeners' Chronicle* in 1931. The articles were intended primarily for the horticulturist, but additions have been made to show the importance of chromosome studies to botanists in general, and it is hoped that the book will now provide a general introduction to the study of plant chromosomes.

Such a study was never so necessary to general agricultural and horticultural workers as it is to-day. It is not too much to say that the recent researches into polyploidy, in which Dr. Darlington has taken a leading part, have revolutionised plant breeders' conceptions of genetic constitution of crops, and not only explained much which was formerly wrapped in mystery, but opened up vast new possibilities of crop improvement.

Plant breeding in these days is so closely linked with all agricultural and horticultural progress, that it behoves all who have an intelligent interest in that progressto know something of its principles. There is too general a tendency to regard the whole subject as too abstruse for any but specialist investigators, and this tendency is undoubtedly due in great part to the absence of simple explanatory texts. Such books as there are deal mostly with the principles established early in the present century, and advance in the last decade has been so rapid that there has scarcely been time for those responsible for it to explain their discoveries to others not possessing their specialised knowledge. Dr. Darlington's exposition is therefore most opportune, and there can be none better qualified for the task. Any who are led to the opposite extreme of thinking the whole subject to be simple, can disillusion themselves by reference to his larger work, "Recent Advances in Cytology", or to his scientific papers.

More explicitly it may be stated that the enquiring horticulturist or agriculturist will find in this book the explanation of what is meant by "a clone" and "apomixis", why seedlings raised from many of the best varieties of apples are useless, how increased proportions of double flowers may be obtained from ever-sporting single-flowered stocks, why "fatuoid" sports appear in oats and "speltoids" in bread wheats, how from the same cross between a raspberry and a blackberry one plant may be sterile and another highly fertile, and many other things of similar interest.

The volume is well illustrated, with both drawings and photographs, and there are references to the original literature for those who have the equipment to push their studies deeper.

E. E. C.

Recent Advances in Agricultural Plant-Breeding.

By H. Hunter, Hon. M.A., D.Sc., and H. Martin Leake, M.A., Sc.D. *J. & A. Churchill*, London, 1933. pp. 343 and Index. Price 15*s*.

We heartily welcome this textbook on a number of grounds, for it meets a definite need, does justice to tropical agriculture in the allotment of its space, and is well-produced. A more personal pleasure in its appearance is derived from the fact that one of its authors was formerly Principal of the Imperial College of Tropical Agriculture.

As its title implies, this work assumes a knowledge on the part of its readers of fundamental principles, both of genetics and of plant breeding, and in no way competes with existing teaching texts. In the words of its authors, an attempt has been made "to present in a connected form the results of only such investigations as have advanced beyond the limits of purely academic interest and the outcome of which has been the introduction of improved varieties into general agricultural use".

The value of the "connected form" can scarcely be over-estimated. The trained plant-breeder who is actually working on a particular crop possesses, if his library facilities are adequate, a detailed knowledge of that crop to which no textbook distinct from a monograph may fairly be expected to add. He finds it most important at the same time to know of other people's problems, not equally minute details, but at least a general outline. Until now such an outline in the majority of cases could only be obtained by the laborious process of finding, reading and abstracting detailed papers scattered over the very wide range of literature that bears on agricultural science. The busy investigator might well be pardoned for neglecting such a task, but now that Dr. Hunter and Dr. Leake have done it for him, and done it extraordinarily well, he has no excuse for denying himself the pleasure of reading their summaries.

The body of the book comprises 158 pages on the crops of temperate regions and 181 pages on crops of the sub-tropical and tropical regions. The division seems very fair, for whilst on the one side there is undoubtedly a greater volume of work to be reviewed in the temperate regions, where the state of knowledge is further advanced and the economic issues involved are possibly at present greater, on the other side the tropical crops present far greater diversity, both with respect to the number of distinct plant families involved and in the nature of the problems they afford for solution.

Tropical agriculture has a bulky literature of its own, but too often appears in general works in a distinctly subordinate position, if at all. This volume has therefore an uncommon unity, which goes far to compensate the consequent brevity of both sections. The essential differences

between temperate and tropical crops are set out in the Introduction, and it is well that both the differences in detail and the underlying community of principles should thus be emphasized at one and the same time.

Space has indeed imposed a severe discipline upon the authors, and perforce some crops have been omitted altogether, but all the major ones are there. It is difficult to suggest any inclusions which might have been sacrificed to alternatives, though personal opinions on that point are bound to vary with critics. Those included in the tropical and sub-tropical section are twenty-two in number, and perhaps a list of them may serve a useful purpose here. They are:—Coffee, cacao, tea, sugar-cane, citrus, banana, tobacco, opium poppy, maize, rice, sorghum, rubber, cotton, sisal, New Zealand flax, jute, coconut, oil palm, castor, ground-nut, sesame, soy bean.

For each of these, as far as possible, the origin and history are sketched, and then the problems of major economic importance are defined. With such an introduction a concise account is then given of any studies of flowering habit, variability, inheritance or cytology, which are to be found in the literature bearing upon the breeder's task, and of the results obtained. The plan of each chapter is naturally determined by the characteristics of the crop and the amount of attention which it has received from research workers, and it is difficult to do justice in a few words to the skill with which some uniformity of plan has been maintained through the diversity of material without omission of any essentials or inclusion of anything unessential. A bibliography follows each chapter, which is a more convenient arrangement than the segregation of all references to the end of the volume.

The type is pleasing and the text free from misprints, whilst mention should also be made of the high standard of the sixteen photographic plates.

"Recent Advances in Agricultural Plant Breeding" is not a book for the layman, but it is very strongly recommended to every plant breeder and economic botanist in the tropics as well as to all other agricultural scientists who have an interest in crop improvement by botanical methods.

E. E. C.

* * *

Cattle Farming in South Africa.

By A. M. Bosman. S. African Agricultural Series No. 10. *Central News Agency*, S. Africa. pp. 453, price 27*s*. 6*d*.

An immense amount of work must have gone to the preparation of this volume, which provides in a very complete form, a guide to those engaged in cattle farming in South Africa, and a most interesting account of the development of the pastoral industry of that country and of the difficulties which it has to meet.

Professor Bosman, who occupies the Chair of Animal Husbandry in the University of Pretoria, takes an eminently sound view of the cattle industry in South Africa. He faces the fact that though South Africa is in the main a pastoral rather than an agricultural country, yet conditions of soil and rainfall are not generally suitable for the production of the highest class of cattle, either for beef or for milk, and, reasoning that the "plane of nutrition determines the quality that can be bred", advocates a strong admixture of the local Africander animal in the type of cattle to be kept. The policy he adopts is outlined in Chapter XIV; the grading up of a herd of indigenous cows for two successive generations by the use of pure bred bulls of a suitable imported beef breed is permissible, but then he would go back for one generation to the use of pure-bred Africander sires. This process is to be repeated, so that after every two infusions of blood of the early maturing beef breeds, there is a top cross of the pure bred improved indigenous stock. Professor Bosman, in our opinion, makes out a very good case for this policy, which he holds in the face of considerable opposition from those who urge that, as by proper management the natural pasture can be improved, the aim of the breeder should be to produce a better type of animal than can ordinarily exist on the veld. He cites the weights obtained at the Pretoria University Farm by Africander bulls to show that they compare favourably with similar animals of the imported beef breeds, and stresses the point that, urgent as the need is for improving the veld—and he makes a special appeal for a combined effort between botanists, animal husbandrymen, agronomists and chemists, to co-operate in this problem—not much improvement has as yet been effected. Little is known about the carrying capacity of the veld, about the normal succession of plants, especially under such treatment as judicious burning, about continuous grazing on the open range, or about deferred and rotative systems of grazing. It will be many years before the valuable qualities of the Africander, pure bred or otherwise, such as its natural adaptability, its hardiness, and its rustling qualities can be dispensed with, in favour of the earlier maturity and better beef conformation of the imported breeds.

The reviewer first came across the Africander breed when considering the production of a work-meat type of animal in Portuguese East Africa. The use of Africander bulls was indicated and recommended, but at the same time there was evidence that this breed possessed a good proportion of Devon blood, which might have proved a source of weakness in the trying conditions in which they had to live and work. It is interesting to note that Professor Bosman denies that this breed owes anything of its colour or its conformation to the use of imported European sires; he claims that it is, and has been for a very long time, a pure breed of indigenous cattle.

Professor Bosman is a supporter of the Show and the Show Card; he indeed devotes a whole chapter to the preparation of cattle for the Show. The modern tendency is to get away from the Show towards the utility record, and this tendency

might have been more emphasised. The formation of a Dairy Cattle Improvement and Milk Recording scheme, to which Professor Bosman accords his unqualified approval, is a case in point.

Parts II and III deal with the Principles of Breeding and with Feeds and Feeding. The author depends on rather out-of-date standards for working out his rations, and no mention is made of the work of the Cambridge Animal Nutrition Research Institute. The working ox is hardly mentioned at all, and it is suggested that he deserves a section in the next edition.

But for the whole work there can be nothing but praise, and it may be recommended to all who have to deal with cattle in the tropics. It is light and easy to handle and read, and the illustrations are excellent; unfortunately the same cannot be said of the maps. It is, as with all this series, rather expensive, and its utility might be increased by republishing it in sections, for the sake of a wider public than can afford the full price.

R. C. W.

* * *

RUBBER LATEX.

By H. P. Stevens and W. H. Stevens. *The Rubber Growers' Association, Inc.*, London, 1933. pp. 147 and Index.

This booklet is the second edition of a pamphlet entitled "Latex", which was written by H. P. Stevens, and published in 1928. It was originally compiled with a view to providing information to enquirers who desired to know the uses and applications of rubber latex. It is not a text book, and consequently, exhaustive references to the enormous literature of rubber chemical technology are not given, but a general bibliography and a long list of abstracts of patent specifications are included. A few good reproductions of photographs of factory equipment are given, but these might have been improved by the addition of descriptive titles. The booklet accomplishes its object; it is clearly written, attractively printed and well arranged; it should be read by all who are interested in the technical application of rubber latex in its ever extending fields of usefulness.

F. H.

* * *

THE ROMANCE OF EMPIRE DRUGS.

Issued by the Scientific Department of *Stafford Allen & Sons, Ltd.*, pp. 135, price 1s.

An attractively bound little volume which contains a brief note, and in most cases, an illustration, of over fifty different kinds of drugs which are produced in the British Empire. Half of these are of importance to the farmer in the Tropics, who will find this little book a mine of information, as well as a most interesting account of some little-known products. Many of the photographs are of crops growing at Long Melford in England, where this enterprising firm have a farm and factory. A very good shilling's worth.

R. C. W.

LE COTON EN AFRIQUE TROPICALE.

By Paul E. A. Janssens. *Ateliers R. Bausart*, Bruxelles, 1932. Price 14 Belgas, pp. 402.

In this rather pretentious work, the author endeavours to deal with all the practical aspects of cotton growing in Africa. The book which is described in the preface as a "Vade Mecum cotonnier", is in two sections, the first dealing with cotton growing generally, and the second giving information about the industry in each of the cotton producing countries. The book is a compilation, rather than an original work, but it fills a useful purpose, and may be recommended to those who wish to learn what other countries are doing to develop cotton production in their African Colonies.

There are signs of hurried preparation—Sir George Watts, for instance, is referred to as Sir P. Watts, Sir John Watts, as well as correctly—but the book is clearly printed, and well illustrated.

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BIBLIOGRAPHY OF TROPICAL AGRICULTURE, 1931.

International Institute of Agriculture, Rome, 70 pp. Price 10 liras.

This compilation of the 1931 literature on tropical agriculture cannot be described as being comprehensive. It contains, however, useful references to foreign papers on tropical crops which might have been over-looked by British workers.

G. G.

VEGETATIVE PROPAGATION.

Budding Mangoes.

It is contended in an article published in the *Journ. Jamaica Agr. Soc.* (1932. 36) that the theory that mangoes could only be budded by the patch bud method is incorrect. The patch bud method is wasteful since only bud wood an inch and a quarter in diameter can be used, the smaller buds having to be thrown away. Evidence is brought to show that the mango can be quite well budded by the ordinary T bud method, the names of growers practising this method being given. An improvement suggested to the author by Mr. F. A. Stockdale, Agricultural Adviser to the Secretary of State for the Colonies, is to trim off the corners of the flaps of bark on the stock at the junction of the vertical and horizontal cuts of the T, the cut portion being covered with the tying material when the bud is inserted. This allows for the greater callusing of the mango, as compared with citrus, which otherwise may be liable to lift the bud.

Avocado Grafting.

The author, again quoting Mr. Stockdale, suggests that the avocado should be cleft grafted, and that, after stock and scion have been well bound together, the whole should be covered with a cardboard or paper cap or cylinder of sufficient length to cover the cleft. This, he claims, should ensure a very high percentage of success.—(*Horticultural Abstracts*, Vol. II, No. 3.)

WEST INDIAN NOTES.

(Compiled by the Advisory Department of the Imperial College of Tropical Agriculture.)

The Fruit and Vegetable Industry.

The orange and grapefruit season has virtually ended in the Leeward and Windward Islands. Dominica exports, as predicted in the last quarterly notes, exceeded those of the previous season.

	Oranges. Crates.	*Grapefruit. Crates.*	*Totals.*
1931-32 Season ..	2,742	2,015	4,757
1932-33 Season .. (to end January)	3,268	3,473	6,741

In addition, the 1931-32 figures shown above include 138 cases of oranges and 572 cases of grapefruit shipped during February and March. The February-March shipments this season, however, will be relatively lighter. Prices have been fairly well maintained and the net returns to the growers per case from the packing shed should average about 8*s*. for oranges and 6*s*. for grapefruit. The bulk of the fruit has been marketed in the Maritime provinces of Canada after filling relatively small Bermuda orders, but about 1,000 cases of grapefruit were diverted to London in December and January in view of relative market conditions. The Canadian market prices usually seem to drop during the latter part of November and during December, particularly with grapefruit, presumably because of the colder weather. By far the larger proportion of the oranges were sold in St. John, advantage being taken of the fact that the boats carrying Jamaica fruit go direct to Halifax, thus necessitating an extra rail charge if this fruit is to be put on the St. John market. St. Lucia's exports this season have been limited to 335 cases of oranges (mostly seedlings) and 72 cases of grapefruit, practically all of which has been sold in Bermuda. Some 300 cases of grapefruit have been shipped from Grenada, mostly to London, and exports next season both from Grenada and St. Lucia should begin to show an increase from new plantings.

Shipments of green limes to New York have been limited in recent months, largely because of the usual short supply at this time of the year. During the three months, November to January, Dominica exported 1,020 barrels to New York; approximately the same quantity as that exported during the same period in 1931-32, viz.: 1,164 barrels. The green lime export to New York in 1932 showed a decrease, as illustrated below, but an increased export is expected this year with the new plantings coming into bearing.

Barrels of Green Limes to New York.

	1931.	**1932.**
Dominica	10,530	7,632
St. Lucia	3,282	3,085

The tomato industry has suffered severe reverses this season. As previously recorded, the early season weather conditions caused much loss of fruit and wastage after packing, and this was followed by very cold weather in Canada, which, combined with the present low buying power of the Canadian public, has resulted in bad market conditions. The diversion of the Bahamas crop to Canada because of the duty imposed by the United States, combined with the present limited demand owing to economic conditions, is resulting in an over-supply for the present market, which under better financial conditions might be capable of absorbing at remunerative prices the quantity of fruit at present being imported. Fruit shipped in the New Year has been arriving in better condition with the drier growing weather, but there are indications that the dry season is already closing down the crop in the Northern Leeward Islands. Small shipments to New York have proved unsuccessful, as was expected with the tariff disadvantages, and market reports have been very contradictory regarding the pack and fruit quality. A shipment of 800 20-lb. crates of "gems" which were already packed when bad market reports were received from Canada, was sent to London. The fruit arrived in sound condition but the shipment showed a loss, particularly because of the extreme market prejudices against stemless fruit and variable maturity on arrival, conditions which are almost unavoidable when shipping to such a distant market. Steps are being taken to increase the average maturity on arrival of fruit for Maritimes markets owing to ripening difficulties experienced with the cold weather. This matter, however, needs careful handling if the landing of over-ripe fruit is to be avoided. The percentage of small fruit is still too high and increased use of fertilisers and better cultivation practices are essential. Montserrat exported a total of 6,112 crates to all destinations up to the end of January, and Nevis about 1,000 crates. Further exports will total about 2,000 and 1,000 crates respectively. The main St. Vincent crop is only just commencing and some three or four thousand crates should be exported. Better market conditions are expected now that the weather is getting warmer in Canada, the Bahamas crop peak is passed, and non-Empire shipments are more controlled by a fixed tariff of 2 cents per lb., the tariff last season being 30 per cent. of the value.

Steps are being taken in St. Lucia, in view of the revised legislation shortly coming into force, to license packing houses in readiness for the mango and avocado pear export seasons. This is expected to increase the proportion of fruit packed by the Government Packing Shed with consequent better control on export quality. This licensing also covers the sheds used for packing limes for export to the United States of America.

In response to representations made, the Canadian National Steamships have reduced the exchange on freight charges to Bermuda from Canadian currency exchange to a fixed ten per cent. This will be of decided value to the mango and pear trades in St. Lucia, Dominica and St. Vincent.

The 1932 operations of the Dominica Government Marketing Depot show a quantity packed of a total f.o.b. value of £4,863, of which £3,078 worth was also sold by the Depot on behalf of growers. The quantity of fruit packed is an appreciable increase over previous years and in almost all instances the net returns to growers were satisfactory.

* * *

The Citrus Industry.

Limes.—The young trees planted in Dominica during the last few years are making good growth. It will be recalled that owing to the incidence of red root disease it was found necessary to bud or graft the lime on to sour orange stocks. It is estimated that close on 1,500 acres have been replanted during the past five years. With this acreage established in Dominica and taking into account the increased acres planted in Trinidad, St. Lucia and Montserrat, it is now considered that the probable lime product requirements will be met.

The green lime trade is in its early stages in Trinidad at the present time. Last year exports of green limes from Trinidad amounted to less than 200 barrels of which 100 went to Canada for advertising purposes.

Grapefruit and oranges.—Grapefruit and orange exports for the 1932-33 season from Dominica have exceeded those of the previous season and the reports from both England and Canada have been most favourable. Two new varieties of oranges have recently been introduced through the Dominica Agricultural Department from the United States. It is hoped that one of these will prove to be earlier than the Washington Navel and the other later than the Valencia. A survey recently made by the Agricultural Department indicates that there are 450 acres devoted to grapefruit, oranges and lemons in Dominica.

Grapefruit juice.—A successful trial shipment of grapefruit juice is reported from Trinidad and a repeat order has been received. This method of dealing with cull fruit may prove most economical.

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The Sugar Industry.

Record sugar crops are anticipated for 1933 in Antigua and St. Kitts, the Antigua crop being estimated at 23,000 tons and the St. Kitts at 22,000 tons. The factories concerned will have, in order to complete the crop, to grind well on to the second half of the year.

Mention has already been made in these notes* of the successful working of the Fowler Gyrotiller introduced into Antigua in 1931. Many of the fields cultivated with this implement will be reaped for this crop and the results are awaited with interest. One of the leading planters has recently imported a 20 H.P. "Caterpillar" tractor which it is intended to use for pulling an implement designed for inter-row work. "Caterpillar" tractors are now to be seen in most of the islands and are proving their worth in sugar-cane agriculture. British Guiana planters were the first in the West Indies to use them on a large scale and Trinidad, where many tractors are now in use, followed in 1924. St. Lucia imported a 30 H.P. "Caterpillar" in 1932. It is hoped that other planters in Antigua and St. Kitts will realize the advantages of deep cultivation which is made possible by this form of traction.

An interesting experiment in sugar-cane transport will be carried out this year in Trinidad, St. Vincent, Antigua and St. Kitts, where the use of carts fitted with roller bearing axles and wheels with pneumatic tyres of a special construction introduced by the Dunlop tyre manufacturers will be tried. Much is claimed for this type of axle and wheel which it is hoped may reduce the cost of transport of canes to the railway sidings.

At a meeting of the Agricultural Society of Antigua, Mr. Warneford, the Agricultural Superintendent, reviewed the most important points in Professor Hardy and Mr. McDonald's report on Antigua soils which is shortly to be published. The soil samples were collected by the two authors in April, 1932, from profile pits which were previously selected by the Agricultural Superintendent as being on typical sugar-cane areas, and as a result, fundamental information on the newer aspects of soil science has been presented in this report. A soil map of Antigua and a set of soil profile charts have been presented to the Antigua Agricultural Department by Professor Hardy.

The sugar-cane breeding work which has been carried on in Barbados for many years is to be extended so as to include the requirements of other West Indian Islands. With funds provided by the Empire Marketing Board, a Central Cane Breeding Station has been established in Barbados. An Advisory Committee, consisting of the Director of Agriculture, Barbados, as Chairman, and of representatives from the Imperial College of Tropical Agriculture, the Departments of Agriculture of Trinidad and Jamaica and the Advisory Department of the Imperial College, has been appointed to advise on the policy of the scientific work of the station. A meeting of this Committee was recently held in Barbados.

In connection with this development Dr. A. E. S. McIntosh, Geneticist to the Barbados Department of Agriculture visited St. Kitts in January and Trinidad in February and proposes to visit Antigua in May. These visits will enable Dr. McIntosh to appreciate the local requirements of the Islands with reference to their different soil and climatic conditions. It will be necessary for the Island Agricultural Departments to undertake the collection of statistics from the various estates regarding the performance of the present cane varieties under the varying soil conditions if the fullest possible use is to be made of this new organization.

* January, 1932.

There will also be the need for trials of new varieties on a more extensive scale. It is expected that there will be the closest co-operation with the sugar estates in this work.

The development of the work of the Froghopper Investigation Committee in Trinidad which resulted in the formation of the present Sugar-Cane Investigation Committee is of great interest, not only to Trinidad but to the other West Indian Islands. The froghopper problem has embraced the study of the entomological, cultural and manurial aspects of sugar-cane cultivation. The methods evolved for studying these problems could be followed with advantage in other sugar producing islands. In particular, important economic results are likely to arise from the work which is being done on the manuring of sugar-cane, articles on which have, from time to time, appeared in *Tropical Agriculture*.

Dr. Myers has returned to Trinidad after an extended tour of the interior of South America where he has been searching for a froghopper parasite. Dr. Myers has been unable, so far, to find such a parasite but he is optimistic regarding a new parasite for the moth borer (*Diatraea*), which he hopes will prove useful to British Guiana. It may be that this new parasite will also suit the conditions in the cane fields of St. Lucia.

A revival of cane farming in Nevis has been made possible by the action of the Basseterre Sugar Factory which has undertaken to purchase sugar-cane. Local agents have been appointed and public weighbridges erected at two convenient centres in the Island. With the drastic reduction in the cotton area which has become necessary, this outlet for the energies of the Nevis peasant is more than welcome.

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The Live-Stock Industry.

Promising results have followed the introduction of the Black Headed Persian sheep from South Africa through the Trinidad Department of Agriculture. These sheep are particularly well suited to the drier Islands and some excellent crosses have been secured with the local breeds.

At the Trinidad Government Stock Farm sale held last December the following animals were purchased and subsequently shipped to the Islands:—To St. Lucia: a grade Holstein bull; a Black Headed Persian ram and ewe; to St. Kitts: a pure bred Holstein bull, two pure bred Holstein heifers, one Berkshire boar and several pens of poultry. Subsequent to the sale a pure bred Persian ewe with two lambs were purchased for Nevis.

The possibility of developing a beef trade between Montserrat, Nevis, the Virgin Islands and Trinidad has recently received consideration. There has also been a marked improvement in the demand for working animals for these Islands. To maintain this trade it is necessary to provide suitable breeding stock. Much has been done in Montserrat and in Nevis in this direction where Zebu bulls of excellent breeding have been imported during the last few years.

Marketing Officer.

The first annual report of the Marketing Officer has been published and a limited number of copies is available for distribution. These may be obtained on application to the Advisory Department at the College. Mr. Shill's efforts, which have been made possible by means of a grant from the Colonial Development Fund are much appreciated by those who are closest in touch with his work. His headquarters which for 16 months were in Dominica have now been moved to St. Lucia where he will reside at least to the end of August.

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Miscellaneous.

Mr. G. B. Gregory, Agricultural Assistant, St. Kitts, paid a brief visit of inspection to Anguilla leaving St. Kitts on 1st February and returning on 7th February.

Dr. Harland, Cotton Adviser to the Commissioner of Agriculture paid an official visit to Carriacou, Union Island and St. Vincent, returning to Trinidad on 18th February.

Professor H. A. Ballou, Commissioner of Agriculture, attended a meeting of the Advisory Committee of the Central Cane Breeding Station held in Barbados and was away from Trinidad from 19th to 26th January.

Mr. F. A. Nichols, Agricultural Assistant, St. Lucia, has been granted three months leave of absence to date from 31st March. During his leave Mr. Nichols will visit a number of Research Institutions in Great Britain.

Dr. Myers of the Imperial Institute of Entomology left Trinidad on 15th March by airplane to investigate the progress that is being made in the study and control of the sugar-cane moth borer in Antigua and St. Kitts.

Mr. A. C. Shill, Marketing Officer, left Dominica on 10th January and paid a visit to Montserrat, St. Kitts, Nevis, St. Vincent and Grenada. Mr. Shill returned on 26th January to St. Lucia, where he will be stationed during the next few months.

Members of the Closer Union Commission visited the College on 13th February. They made careful enquiry into the working of the Agricultural Advisory Department which is concerned more particularly with the agricultural problems of the Leeward and Windward Islands.

Mr. G. A. Jones, Assistant Commissioner of Agriculture, made a tour of the Leeward Islands leaving Trinidad on 29th December and returning on 4th February. On 8th March he travelled by air to St. Lucia and after a stay of six days, proceeded to the Leeward Islands by steamer. Mr. Jones is not expected to return to Trinidad before the first week in May.

THE subscription to *Tropical Agriculture* is six shillings per annum, post free, Trinidad currency, to all countries within the British Empire or seven shillings and sixpence, post free, Trinidad currency, to all other countries. Subscriptions can commence at any time during the year.

A SENSITIVE POT TEST FOR PHOSPHATE DEFICIENCY IN SOILS.

By J. A. McDonald.
(*Department of Chemistry, Imperial College of Tropical Agriculture.*)

(I)—Introduction.

As a result of recent investigations carried out by the College Department of Chemistry on the soils of Trinidad, Tobago and Grenada (1, 2), it has been found that the available phosphate content of cacao soils appears to be a very important factor in their productivity. In order to assess available phosphate content, the Truog colorimetric chemical method (3) has been used. This method has recently been subjected to critical examination in the United States of America, and has shown good agreement with pot tests and field trials (4, 5). In the present investigation, pot tests have been carried out on a number of cacao soils whose phosphate status had previously been determined by the Truog method. Use has been made of the peculiar sensitivity of the Tomato plant to phosphate deficiency in the soil. As a result of these tests, a simple method has been evolved by means of which soils may rapidly and easily be tested for phosphate deficiency.

(II)—The Tomato Plant as Indicator of Phosphate Deficiency in the Soil.

Tomato plants have been shown to be very sensitive to soil phosphate deficiency (6, 7); Mayer has recently detailed a number of characteristic symptoms shown by Tomato seedlings grown in phosphate-deficient soils. The chief symptoms are:—

(1) Upward inclination of seed leaves, forming an acute angle.
(2) First pair of true leaves remain unparted at the tips.
(3) Dark-green colour develops on the upper side of the leaves.
(4) Violet-red colour develops on the lower sides of the leaves, and on the young stems.

(III)—Preliminary Tests.

(A)—In order to verify Mayer's findings, a preliminary test was run on two soils whose available phosphate contents (Truog) were widely different.

Procedure.—Earthenware flower pots, holding about 9 lb. (4 kilograms) of wet soil, were used; twelve seeds were planted in each, and, after about three weeks, all but three plants were removed; these were then allowed to grow for two months, after which period they were reaped, and the weight of dry matter determined. The soil from each plot was sampled for determination of available phosphate content by the Truog method. The results obtained are presented in Table I.

The plants grown on the phosphate-deficient soil showed the following symptoms; (1) Purple colour of underside of leaves (most marked after 10 to 20 days growth), (2) Darker green colour of the stems and foliage up to the time of reaping.

TABLE I.

Locality and Soil Type.	Culture.	Available Phosphate in soil after reaping (p.p.m.)	Dry Wt. at 62 days (gm.)	Foliar Symptoms of Phosphate Deficiency.
Torrecilla Estate (Sandy alluvium)	A	93	13.0	Absent.
	B	112	13.7	Absent.
Las Hermanas Estate (Clay alluvium)	C	18	1.7	Pronounced.
	D	27	4.6	Pronounced.

The foliar symptoms detailed by Mayer for the very young seedlings were not obviously apparent, but the total dry matter obtained from the high-phosphate soil was more than four times greater than that obtained from the low-phosphate soil.

The striking difference in growth obtained is indicated by Figs. I and II.

(B)—The same two soils were used, and the effect of adding soluble phosphate (calcium hydrogen phosphate) was tested.

The results obtained are presented in Table II.

The results showed: (1) that the addition of soluble phosphate to the low-phosphate soil greatly increased the weight of dry matter obtained after 60 days growth, (2) that the addition of soluble phosphate to the high phosphate soil caused no increase in the yield of dry matter (indeed, the cultures containing added phosphate gave a slightly lower average yield than the controls), (3) foliar symptoms of phosphate deficiency were apparent only in pots A and B (untreated, low-phosphate soil).

Conclusions.—These findings serve to demonstrate the possibility of using Tomato plants as a simple and rapid means of indicating phosphate deficiency in soil by noting the following facts:—(1) Increase in weight of dry matter obtained on addition of soluble phosphate, (2) Characteristic foliar symptoms of phosphate deficiency.

It was noted in the preliminary tests that the foliar symptoms were most pronounced when the plants were 10 to 21 days old, and that, after about four weeks (owing perhaps to their restricted environment) all the plants became straggling and unhealthy, and thence forward growth was erratic, causing some unevenness in the dry weight of material obtained from duplicate pots. It was therefore decided in future

A SENSITIVE POT TEST FOR PHOSPHATE DEFICIENCY IN SOILS.

FIG. I.—A.B.—*High Phosphate Soil.* C.D.—*Low Phosphate* (13 *days growth*).

FIG. II.—A.B.—*High Phosphate Soil.* C.D.—*Low Phosphate* (62 *days growth*).

A SENSITIVE POT TEST FOR PHOSPHATE DEFICIENCY IN SOILS.

FIG. III.—(i) *Brasso Clay.* A.B. *Untreated Soil.* C.D. *Soil+Superphosphate* (24 *days growth*).

FIG. IV.—(ii) *Sandy Alluvium.* E.F. *Untreated Soil.* G.H. *Soil+Superphosphate* (24 *days growth*).

FIG. V.—(iii) *Clay Alluvium.* I.J. *Untreated Soil.* K.L. *Soil + Superphosphate* (24 *days growth*).

TABLE II.

Locality and Soil Type.	Culture.	Phosphate added (gm.) (calc. hydr. phosph.)	Available Phosphate in soil after reaping (p.p.m.)	Dry Wt. at 60 days (gm.)	Average Dry Wt. (gm.)	Foliar Symptoms of Phosphate Deficiency.
Las Hermanas Estate (Clay alluvium)	A	—	27	1.80	1.57	Pronounced.
	B	—	29	1.35		
	C	2.0	126	3.60	3.05	Absent.
	D	2.0	128	2.50		
	E	1.0	70	3.50	4.25	Absent.
	F	1.0	64	5.00		
Torrecilla Estate (Sandy alluvium)	G	—	122	10.40	9.45	Absent.
	H	—	127	8.50		
	I	0.5	198	8.30	8.85	Absent.
	J	0.5	179	9.40		
	K	1.0	217	9.10	8.55	Absent.
	L	1.0	204	8.00		

tests to grow a greater number of plants and to reap them at three to four weeks intervals, instead of at two months as recommended by Mayer.

The following details for carrying out the test were finally decided.

(IV)—Proposed Method.

(1) *Sampling.*—A number of soil samples, six to eight inches deep, are taken from the selected area, and mixed together. The composite sample is air-dried and pulverised, so as to break up the larger lumps.

(2) *General Procedure.*—Ordinary flower pots are used, a convenient size being one that will hold about 9 lb. (4 kilograms) of moist soil. Four pots are required for each soil to be tested. Two pots are filled with untreated soil, and, to each of the other two pots, two to three grams of superphosphate of lime are added. Twenty to thirty tomato seeds* are planted in each pot to allow for failures in germination. Three to four days after germination, the number of seedlings is reduced to twelve. After three to four weeks growth, the ten healthiest plants from each pot are reaped, and the weight of oven-dry matter is determined. Indications of phosphate deficiency of the soil are obtained as follows:—

(*i*) Percentage increase in weight of dry matter obtained by treating the soil with phosphate.

(*ii*) Appearance of the plants with regard to presence or absence of (*a*) dark green colour, (*b*) purple colouration of undersides of leaves.

*In the tests described, variety *Ponderosa*, supplied by the Landreth Seed Co., Pennsylvania, U.S.A., were used.

(V)—Application to Trinidad Cacao Soils.

Three soils were selected which are typical of large areas under cacao in Trinidad. The chief physical and chemical characters of the surface six-inch layers of these soils are given in Table III. The results of the Tomato Pot Test for phosphate deficiency are shown in Table IV.

The results indicate that all three soils are deficient in available phosphate. Soil No. 3 shows the greatest deficiency.

The indication of phosphate deficiency obtained for soil No. 1 is interesting in view of the high value for phosphate content obtained by the Truog method for the control cultures. The striking differences in growth obtained are illustrated in Figs. III, IV and V.

(VI)—Discussion.

The Tomato test is qualitative rather than quantitative, but nevertheless it offers certain advantages over quantitative chemical tests. Whereas chemical methods for determining soil phosphate have shown good agreement with pot tests, and with field trials for *acidic and neutral soils*, it is doubtful whether chemical methods furnish reliable means of testing phosphate deficiency in *calcareous soils* of high alkalinity. It has recently been shown (8) that, in highly calcareous and alkaline soils, phosphate may be present in a form unavailable to the plant.

The Department of Chemistry is at present engaged in an investigation of the soils of Antigua, B.W.I., and a number of highly alkaline, calcareous

TABLE III.

Soil Type and Locality (Trinidad)	Sand (%)	Index of Texture (I.T.)	Reaction (pH.) Norm.	Reaction (pH.) Exch.	Organic Matter Content (%)	Nitrogen Content (%)	Carbon/Nitrogen Ratio.	Avail. Potash (p.p.m.)	Avail. Phosphate (p.p.m.)
1. Brasso Clay (Central Range) ..	13.5	40	6.3	5.5	2.14	0.23	5.4	114	79
2. Sandy Alluvium (Northern Range) ..	53.7	23	6.7	6.2	1.80	0.16	6.5	150	21
3. Clay Alluvium (Caroni Plain) ..	9.4	47	6.2	5.4	2.99	0.27	6.0	139	29

TABLE IV.

Soil Type and Locality (Trinidad)	Culture	Phosphate added (gm.) (calc. hydrogen phosphate)	Available Phosphate in soil after reaping (p.p.m.)	Dry Wt. of Plants (gm.)	Average Dry Wt. (gm.)	Per cent. Increase of Dry Wt.	Foliar Symptoms of Phosphate Deficiency.
1. Brasso Clay (Central Range)	A	—	84	1.32	1.14	—	Pronounced.
	B	—	74	0.96			
	C	1.75	102	3.08	3.89	241	Absent.
	D	2.00	105	4.69			
2. Sandy Alluvium (Northern Range)	E	—	29	1.01	1.07	—	Pronounced.
	F	—	27	1.14			
	G	2.15	52	3.52	3.17	196	Absent.
	H	1.95	41	2.81			
3. Silty Clay Alluvium (Caroni Plain)	I	—	23	0.19	0.24	—	Pronounced.
	J	—	22	0.29			
	K	1.90	36	1.57	1.56	550	Slight.
	L	1.95	39	1.55			

Antiguan soils have been tested for phosphate deficiency by the Tomato seedling method. The samples of soil obtained were small, and therefore the test had to be modified considerably. It is interesting to note, however, that a number of soils which showed a high phosphate content by chemical methods, showed a marked phosphate deficiency when examined by the Tomato test. It is possible also that in certain other exceptional cases, the values obtained for phosphate content of the soil by chemical methods may be misleading (for example, Soil No. 1), and, in such cases, biological methods, such as the proposed Tomato seedling method, should prove extremely useful in determining the true phosphate status of the soil. It will be noted that, in this investigation, no attempt has been made to study the effect of adding nitrogen and potash to the soils tested, since, in this case, it is an increase over the natural soil (rather than a decrease from the maximum as in the Mitscherlich test) that is being measured. The proposed test has the advantages of rapidity and simplicity; modifications in technique may readily be made to suit individual requirements.

(VII)—Summary.

(1) Tomato plants, grown in soils deficient in available phosphate, show definite foliar symptoms associated with phosphate deficiency.

(2) The addition of soluble phosphate (superphosphates, &c.) to such soils results in greatly increased growth, and in the disappearance of the foliar symptoms.

(3) Based on these findings, a simple and rapid pot test has been elaborated, by means of which the available phosphate status of a soil may readily be determined.

(4) Results obtained by applying the test to certain cacao soils of Trinidad are presented and discussed.

(5) It is indicated that this test may be of great value in investigating the phosphate status of certain soils in which values obtained by chemical methods may be misleading.

(VIII)—References.

1. Hardy, F., McDonald, J. A., and Rodriguez, G. Studies in West Indian Soils (IV). The Cacao Soils of Grenada. Supplement to *Tropical Agriculture*, 1932.

2. First Annual Report on Cacao Research. *Imp. Coll. of Trop. Agric.*, Trinidad, 1931.

3. Truog, E. A Proposed Method of Determining Readily Available Phosphorus of Soils. *Journ. Amer. Soc. Agron.*, 1930, XXII, p. 874.

4. Rost, C. O., and Pinchney, R. M.—Colorimetric Methods for Determination of Readily Available Phosphorus in Soils. *Journ. Amer. Soc. Agron.*, 1932, XXIV, p. 377.

5. Snider, H. J. A Comparison of Methods for Determining the Availability of Phosphorus in the Soil. *Journ. Amer. Soc. Agron.*, 1932, XXIV, p. 680.

6. Mayer, L. Tomato, A Sensitive and Rapid Indicator of Phosphate Deficiency in Soils. *Forts Landw.*, 1929, IV, p. 684; Abstract in *Journ. Soc. Chem. Indus.*, 1930, XLIX, p. 922.

7. Owen, O. The Effect of Manurial Treatment on the Composition of Tomato Foliage. *Journ. Agr. Sci.*, 1931, XXI, p. 442.

8. McGeorge, W. T., and Breazeale, J. F. Relation of Phosphate Availability, Soil Permeability and Carbon Dioxide to the Fertility of Calcareous Soils. *Arizona Agric. Expt. Sta., Tech. Bul.* 36, 1931, p. 361.

STUDIES IN TROPICAL LAND TENURE.

By H. Martin Leake, sc.d.

VII.—Mauritius.

The history of land tenure in Mauritius bears a certain similarity to that of the West Indies. In the case of the latter small attention, in the spirit of those early times, was paid to any rights of the indigenous population and land became freely distributed among the conquerors; in the case of the former, the absence of any indigenous population removed any question of such rights and land was distributed with the same freedom. In climate and in the range of crops there lies a further similarity and, lastly, Mauritius, like many of the West Indian Islands, passed to Britain from the possession of another European nation.

There is evidence that the group of islands, the Mascarenes, named after Pedro Mascarenhas who discovered Mauritius and Bourbon in 1505, was known to the Arabs and visited by the Malays who colonized Madagascar during the fifteenth and sixteenth centuries. Mauritius itself was visited by the Portuguese by whom it was named the Ilha da Cirnos or Isle of Swans. Possession was first taken by the Dutch in 1598 but no settlement was effected till 1638. From that date spasmodic settlement took place but the island was finally abandoned in 1710. In 1715 possession was taken by the French but not till 1735 was any permanent settlement effected when real progress was made under the brilliant leadership of the Governor, M. Labourdonnais. In 1764 the French Government assumed direct control of the island, taking over from the Cie. des Indes Orientales. This neglect of an island, though partly due to the absence of an indigenous population, is somewhat surprising in view of its strategic position flanking the route to India. During the Napoleonic wars it became a base for ships menacing the trade routes to the east and the removal of that menace was the principal cause of the attack made on it in 1810 as the result of which it capitulated to the English. From that date it has formed an integral part of the British Empire.

Under the French the land passed to the settlers whose claims were established under French Law uncomplicated by any question of native rights. Development was, however, slow, being limited by the difficulty of securing labour which, in the early stages, was supplied by slaves procured from Africa. As in other colonies, slavery was abolished in Mauritius in 1835 and its abolition only added to the labour difficulty. It was not till 1842, when Indian labour was introduced on the indenture system, that the demand for labour ceased for a time to be the dominating factor influencing agricultural progress.

Steps were early taken to regularize the position of settlers with regard to the land under the French Administration for, in 1766, was passed the Ordonnance du Roi (Code Delalieu No. 3) which instituted a Land Court (Tribunal Terrier) with jurisdiction defined by Ordonnance du Roi (Code Delalieu No. 96) of the same year. Subsequently, by Ordinance 13 of 1832, the Land Court was abolished and its jurisdiction transferred to the Executive Council sitting as a Land Court while still later, by Ordinance 4 of 1872 the judicial powers exercised by the Executive Council sitting as a Land Court were transferred to Ordinary Tribunals of the Colony. For the purposes of registration, under the French the Edit de Louis XVI of 1776 established at Versailles a depôt, the 'Depôt des Chartres des Colonies', for the preservation and safety of public papers emanating from the Colonies. Registration itself is covered by the Arrêté, Code Decaen No. 36 of 1805, through a system of Notaries established under the Arrêté, Code Delalieu No. 132 of 1777,

with functions fully defined under the Arrêté, Code Decaen No. 49 of 1805. After the capitulation, duplicate minutes and repertoires were deposited at the Registry of the Court of the First Instance while the documents handed over under the terms of the Treaty of Paris were placed in charge of a Colonial Archivist. Proclamation 16 of 1824 regularized the position by creating an office of Archiviste Coloniale. Land in Mauritius, in consequence, consists of Crown Land, the original Domaine, composed of land for which no valid title has been established, and privately owned land held under a registered title. The latter, subject only to such restrictions as may appear in the title deeds, is at the free disposal of the title holder to sell, mortgage or bequeath.

The alienation of Crown Lands had been governed by the Arrêté, Code Decaen No. 144 of 1807 and by Regulations of 1853 and 1864, the validity of grants under the two last being established by the Order in Council d. 31. 3. '65. By Ordinance 18 of 1874 the conditions under which the disposal of Crown lands might in future be effected are more specifically detailed. Free grant or disposal at less than full value is prohibited except for religious, charitable, educational and public utility purposes while sale is to be by public auction. Leases may be granted either as the result of public auction or of private treaty; rules for dealing with that problem, so common where a liberated slave population exists, of the squatter, are formulated. Sale of the 'Pas Géométriques', mountain reserves or river reserves is forbidden. The details of these latter rules fall for consideration more naturally under the discussion of the preservation of the natural amenities. Land acquisition by Government, formerly covered by the Arrêté, Code Decaen No. 185 of 1808, is rendered possible by Ordinance 57 of 1860, the terms of which apply not only to acquisitions by Government for undertakings of public utility but extend to private individuals for any undertaking to which the provisions of the Ordinance are extended by legislative enactment. A further method by which land may pass to the State is covered by the Curatelle Ordinance (Ord. 9 of 1890) which incorporates a series of successive Ordinances dealing with the problem of vacant estates. Of more importance from the agricultural aspect is the Land Acquisition Ordinance (Ord. 25 of 1884-85) which constitutes an amending Ordinance to the Woods and Forests Ordinance (Ord. 10 of 1881). The group of Ordinances to which this belongs is mainly concerned with the preservation of the essential natural features of the island, the forests, water-courses and sea shore. The most important Ordinance of this group is Ordinance No. 13 of 1875 providing for the conservation of Woods and Forests on Crown Reserves and plantations, and to protect water-courses. In it the 'Pas Géométriques' are defined as the area between the sea and a line drawn 250 feet from high water mark; no sale is permitted but land may be leased for a term not exceeding 30 years (Ord. 19 of 1895). For mountain reserves a Base Line is laid down which, subject to the limitation that it shall not be less than 150 feet above sea level, is left to definition. A number of Base Lines are laid down in the Schedule attached to the Ordinance and a survey is directed for the definition of the remainder. From the Base Line a Mountain Reserve Line is calculated in such a manner that its altitude exceeds that of the Base Line by one-third the difference in altitude between that of the Ridge and the Base Line. All land above the Mountain Reserve Line constitutes the Mountain Reserves to which the protective sections of the Ordinance apply whether that land be Crown Land or private property. River Reserves compose the ground on either side of a stream between the ordinary edge line and a line drawn 50 feet away from it (in the case of a river) or 25 feet in the case of a rivulet. By these measures the forests and water supplies are rigidly protected. Water rights were early defined in the time of the French occupation and are now rigidly controlled by Ordinance 35 of 1865. Under this Ordinance, too, the main policy with regard to canals is laid down while regulations for irrigation are formulated in the Irrigation Ordinance (Ord. 41 of 1882).

The foundation of land tenure on which the system of agriculture has been built up is, thus, one of relatively small estates, privately owned and worked on the plantation basis with hired labour. In part, this relatively small unit owes its origin to the fact that, though modified from time to time, the laws of succession as laid down in the French Civil Code are in force (1). The most important modification was introduced by the Donations inter Vivos Ordinance (Ord. 29 of 1912), passed as the result of the Royal Commission of Enquiry in 1910 mainly to meet the desires of the Indian settlers. On this substructure has developed a system of agriculture in which sugar-cane dominates almost to the exclusion of any other exchange culture. This development took place at a time when labour was comparatively abundant owing to the indenture system and before the central factory system, with its lower costs and greater efficiency, had revolutionized the sugar industry. Accompanying this change in the methods of manufacture, the labour problem has assumed prominence owing to the cessation of the indenture system and the fact that large numbers of the Indian immigrants have preferred, as elsewhere, to settle on small holdings in preference to working as paid labourers. The pressure of these forces is bringing about a radical change in the methods of sugar production though a slow one, for reorganization is a more difficult process than new construction. The manufacture of sugar is becoming more and more centralized; the owner of a private estate, accustomed in the past to turn to a 'bailleur de fonds' for his financial needs, has no longer security sufficient to cover the advances he requires; a demand for

small holdings has arisen. In spite of this movement, there are still 43 factories operating of which one only produces 15,000 tons sugar while nine produce between 10,000 and 7,500, 16 between 7,500 and 5,000, and 17 below 5,000 tons. In the modern sense, these are all small. These factories are fed from three sources; the estates to which the factories are attached cultivate 48,525 acres of the total area of 137,182 acres under cane, estates to which no factory is attached and which sell to the factories, cultivate 38,833 acres while small planters cultivate 49,824 acres of which 42,576 acres is Indian (2). The effect of this system is found reflected in the return of cane. Though the area under small cultivators constitutes some 43 per cent. of the total area cultivated, the yield of that area is only some 25 per cent. of the total crop and averages only some seven to nine tons per acre (3). This low yield from the peasants holdings is in some measure attributable to the fact that it was not the best land with which the estates parted, but the margin is sufficiently great to require further explanation. It is, no doubt true that, as Sir Francis Watts wrote in his report (3), if it were possible to effect marked improvements in the agricultural methods of the small cultivators, the general output of the Colony might be considerably raised. A comparison of the conditions here and in Fiji is illuminating.

A further consequence of this subdivision into independent holdings of small size is that it has fallen to the lot of Government to carry out any steps in the direction of co-ordinating agricultural production and Government's activities in this direction are to be traced in the large volume of Ordinances and Proclamations which are concerned with the control of production in all its phases. This tendency to control by direct legislative action was early apparent for, in 1882, an Ordinance was passed empowering the Governor to prohibit or regulate the importation of vine plants (Ord. 14 of 1882) and, in 1885, an Ordinance designed to destroy the Cuscuta creeper (Ord. 21 of 1884-5). Later more comprehensive steps were taken. The Importation of Plants (Disease Prevention) Ordinance (Ord. 4 of 1910) controlled plant importation and it was shortly followed by the Plant Diseases Prevention Ordinance (Ord. 8 of 1911). This latter is a comprehensive Ordinance. Under it a district or area may be declared infected, the destruction or treatment of any vegetable product within that area prescribed, the removal of any plant from within that area prohibited and even the movement of persons, animals, earth, soil, manure and 'other things' into and out of the area regulated. Power is also taken to appoint inspectors for the purpose of control. Advantage has been taken of this Ordinance to endeavour to control that Coleopterine pest of the sugar-cane, *Physalus Smithi*, which is supposed to have been introduced from the West Indies, and a large number of Proclamations have been issued under the Ordinance. Organized efforts have also been made to obtain control through the parasite *Tiphia parallela*, and when these, in their turn, led to an unorganized trade in the parasite which, through lack of skilled handling, was injuriously affecting its abundance, the Beneficial Insects (Protection) Ordinance (Ord. 36 of 1931) was passed under which the sale and distribution of a beneficial insect might be prohibited and the Director of Agriculture was given powers to enter any land for the purpose of survey and collection for distribution to other localities.

Protection against disease is not, however, the only direction in which legislative activity has concerned itself with the sugar industry. In 1898 the Agricultural Loan Ordinance (Ord. 4 of 1898) gave a privileged status to loans against current crops and the Sugar Cane Contracts Ordinance (Ord. 20 of 1905) was passed to facilitate contracts between mill owners and planters. In the realm of marketing a legal status was conferred on the Mauritius Sugar Syndicate by the Mauritius Sugar Syndicate Ordinance (Ord. 31 of 1920) extended by Ordinance 7 of 1921 and Ordinance 5 of 1924. Lastly, the Sugar Industry Reserve Fund Ordinance (Ord. 24 of 1927), by imposing a duty of two cents on every 50 kilos. exported, created a fund for the installation of experimental new machinery, for the financing of a Chamber of Agriculture in England and for meeting the cost of an interchange of experts with other countries.

Legislative activity has also concerned itself with the establishment of other agricultural industries, notably tobacco. In 1928 an Association was given legal status under the Mauritius Tobacco Growers Ordinance (Ord. 2 of 1928) and, in the same year, cultivation of tobacco was regulated by the Tobacco Plantation Regulation Ordinance (Ord. 6 of 1928), the latter Ordinance being replaced in 1930 by the comprehensive Tobacco Production and Marketing Ordinance (Ord. 38 of 1930). Under this Ordinance the control of production and sale of leaf tobacco is vested in a Government Tobacco Board. All land on which tobacco is grown, including seed beds, is to be registered with the Board; all dealers are registered and may only sell to the Board which is to establish a tobacco warehouse and control prices. 50 per cent. of the profit is to be paid as bonus to dealers and growers on a sliding scale taking grade and quantity of leaf into account, while the remaining 50 per cent. constitutes a reserve fund. The initial funds are advanced by Government. Control of mosaic is dealt with under Proclamation No. 51 of 1897 issued under the Plant Diseases Ordinance. Vanilla production is, likewise, controlled by the Vanilla Consolidation Ordinance (Ord. 10 of 1918) under which all growers are registered and the distribution of pods, shoots and cuttings is controlled by certificate issued through the police.

References.

(1) Cmd. 5185; Repts. Commrs., 1910, 42, p. 1.
(2) Ann. Rept., Dept. Agric., 1930.
(3) Cmd. 3518, Repts. Commrs., 1929-30, 8, p. 737.

SUGAR NOTES.

Compiled by the College Department of Sugar Technology.

Results with Lafeuille Crystallizer Pans. *Wm. Paterson.*

At La Carlota, in the Philippines, two Lafeuille crystallizer rotary pans, each of 500 hl. (1,766 cubic feet) capacity, were used for low grade sugar for 1931-32, together with 28 U-type crystallizers each of 240 hl. (847 cubic feet) capacity, the Lafeuille strikes being dried separately in 16-inch by 40-inch by 24-inch centrifugals, and the ordinary crystallizer strikes in 12-inch by 40-inch by 24-inch centrifugals. The Lafeuille pans are directly below two vertical pans, which supply the footing of low grade massecuite for the crystallizer pans, as graining does not take place in the Lafeuilles.

The footing is "built up" with 48-49 apparent purity molasses to the extent of 80 per cent. (511 cubic feet) of the pan, and is then completely transferred to the crystallizer pan under vacuum, the Brix of the transfer mass being 93.0. After the transfer has been completed, the operation of graining and "building up" for the next Lafeuille strike is repeated. Following is the average time for the different operations:—

	Hrs.	Min.
Graining and boiling in vertical pan ..	6	00
Cutting from vertical pan to Lafeuille ..	0	15
Boiling in Lafeuille	6	45
Cooling	4	00
Heating	2	15
Discharging	0	25
Steaming and building-up of vacuum ..	1	00

It was found that for the first week the average boiling time was 12.92 hours, the massecuite being cooled from 78.1 to 36.2°C. in 6.85 hours, then re-heated to 51.6°C., at which temperature it was discharged, the Brix of the massecuite being 94.6° and the apparent purity 52.77°. The molasses resulting from the treatment had 24.50 apparent purity and 30.31 gravity purity.

In the second week the average boiling time was reduced to 10.93 hours and the massecuite was cooled from 81.7 to 42.1°C. in 5.97 hours, then re-heated to 58.6°C. the Brix of the massecuite being 96.16, and the apparent purity 53.65, a point higher in purity than the previous week. The molasses for the second week had an apparent purity of 25.65, and a gravity purity of 31.18, showing an increase of 0.87 in the gravity purity over the previous week. It is noted, however, that the average drying time was reduced from 12 to 8.5 hours.

In the last two weeks of the season a larger volume of low grade was handled, but the massecuites at this time had become increasingly viscous and were being discharged at higher temperatures. When the averages for the last two weeks are compared with the first two weeks of the season, it will be seen that: the boiling time was reduced from 10.13 hours to 6-7 hours; cooling from 6-7 hours to about 4 hours, heating time increased from about 1.4 to about 2.5 hours, and the discharge temperature raised from 51.58°C. to about 71°C. This treatment resulted in an increase in the gravity purity of the final molasses of from 30.31 and 31.18 in the first two weeks to 34.28 and 33.24 in the last two weeks. As a positive result the drying time was considerably reduced from 8-12 hours to about 3-7 hours.

Practical experience with the Lafeuille leads to the following impressions: that after a prolonged boiling, it is not advantageous to cool the masscuite for a longer period than 4 hours; that no advantage is gained by bringing the temperature to below 42°C. on cooling, and that on heating a cooled massecuite to a temperature of 65-66°C., very little or no dissolving of grain occurs.

During a 13-week period from 30th November, to 28th February, when a total of 382,828 metric tons of cane was milled, a total of 313 Lafeuille strikes and 324 ordinary crystallizer strikes were made. The average volume of massecuite of a Lafeuille strike is 380 hl. (1,342 cubic feet) and that of the U-crystallizers, 700 cubic feet. Hence 65.14 per cent. of the low grade was handled on the Lafeuilles, from which it can be inferred that the two Lafeuilles, of 500 hl. (1,766 cubic feet) gross capacity each, can take care of 4.207 by 0.6514=2,740 metric tons of cane per day, equivalent to 1.29 cubic feet per ton of cane per day. Table below shows the average Brix and purities of massecuites and molasses passed through the Lafeuilles and the ordinary crystallizers for the entire 1931-32 season.

	No. of Strikes	Massecuite. Brix.	Massecuite. App. Purity.	Molasses Brix.
Lafeuille ..	537	96.38	53.96	94.51
U-Crystallizer	618	97.30	55.54	90.27

	Molasses. App. Purity.	Molasses. Gravity Purity.	Time in Lafeuille hours.	Time in Crystallizer days.
Lafeuille ..	26.33	32.30	15.0	—
U-Crystallizer	27.17	33.00	—	5.3

Hence, to summarize the results obtained, it is seen that over the entire season the Lafeuille crystallizer pans showed a decided advantage over the old U-crystallizers in the handling of low grade work, the most important of which are: there is complete control of temperature, and of the Brix and the massecuite before discharge: a

IMPERIAL COLLEGE OF TROPICAL AGRICULTURE

COLLEGE NEWS BULLETIN

APRIL, 1933.] [No. 2.

COLLEGE NEWS.

Mr. W. A. Tansley, Bursar, returned from England by s.s. *Orinoco* on 16th January.

* * *

Dr. A. T. Stanton has been co-opted as a member of the Governing Body of the College for a further period of four years.

* * *

We have pleasure in announcing the birth of a daughter on 31st January to Mrs. Gianetti, the wife of Mr. G. Gianetti, College Editor, Librarian and Registrar.

* * *

The thanks of the College are due to Messrs. C. C. Wakefield & Co., Ltd., who have agreed to supply, free of charge, all the lubricating oils required for the Experimental Sugar Factory.

* * *

Professors R. C. Wood and C. Y. Shephard, accompanied by seven students, paid a short visit to Tobago during the Christmas vacation to study certain aspects of the island's cacao and tobacco industries.

* * *

Mr. Robert Williamson has been nominated by the British Empire Sugar Machinery Manufacturers' Association to represent the industry on the Governing Body of the College in succession to the late Mr William Scott Herriot.

* * *

The College Experimental Sugar Factory, which was closed last year, re-opened on 7th March. Seven students are receiving instruction in the operations of the Factory. It is expected that the grinding season will last about seven weeks.

* * *

Mr. A. K. Briant, Lecturer in Mycology, visited St. Vincent from 24th February to 3rd March in order to investigate a Rosellinia disease of arrowroot and allied problems which are affecting the production of the crop in the island.

* * *

The Principal and Professor H. A. Ballou, Commissioner of Agriculture, recently represented the College at the inaugural meeting of the Advisory Committee of the Central Cane Breeding Station for the West Indies which was held in Barbados.

Mr. Basil Wright, the official cinematographer of the Empire Marketing Board, stayed at the College from 4th March to 16th March, inclusive. With the ready assistance of the Staff and students he made a complete film of the various College activities, which should prove of much interest, not only to past and present members of the College, but also to the general public.

* * *

Dr. A. E. S. McIntosh, the Officer in charge of the Central Cane Breeding Station at Barbados, visited Trinidad from 19th February to 2nd March. He made a survey of the conditions under which cane is grown in different parts of Trinidad with a view to recommending the introduction of new varieties. He will base his future breeding programme for Trinidad on the results of this visit.

* * *

The following members of the Staff are expected to proceed on leave this year: Mr. G. Evans, Principal; Mr. R. C. Wood, Professor of Agriculture; Mr. F. Hardy, Professor of Chemistry and Soil Science; Mr. C. Y. Shephard, Professor of Economics; Mr. A. K. Briant, Lecturer in Mycology and Bacteriology; Dr. J. R. Dickson, Medical Officer of Health; and Mr. F. J. Pound, Geneticist to the Cacao Research Scheme.

* * *

Mr. George Moody Stuart, C.B.E., Chairman of the College Finance Committee, who was accompanied by his son, Mr. Alexander Moody Stuart, stayed at the College as the guests of the Principal from 11th to 14th March. A meeting of the College Advisory Committee was held on the 11th and the Governors afterwards had lunch in the College Dining Hall. Various matters connected with the finances of the College and the Advisory Department were discussed during the visit.

* * *

Sir Algernon Aspinall, Secretary of the College in London, and Lady Aspinall, who were in transit passengers on the *Viceroy of India*, paid us a brief visit on 12th January. Sir Algernon and Lady Aspinall lunched with the Principal

and Mrs. Evans, and made an extensive tour of the College. They also attended a garden party, arranged by Mrs. Evans, at which they had the opportunity of meeting the Governors of the College present in the Colony, and all members of the Staff and their families. Sir Algernon, who last visited the College in 1922, was pleasantly surprised at the many changes and developments that have taken place in the past ten years.

* * *

The members of the Commission which was appointed by the Secretary of State for the Colonies to enquire into the possibility of closer union between the Windward and Leeward Islands and Trinidad, visited the College on 13th February and spent several hours inspecting the various Departments. The Commission consisted of General Sir Charles Ferguson, Bart., Chairman, Sir Charles Orr, Member; and Mr. McNeil Campbell, of the Colonial Office, as Secretary. Evidence was taken from the Principal and other Officers, especially with regard to the functions of the Advisory Department of the College.

* * *

A party consisting of eighteen Post Graduates accompanied by the Principal, Dr. Briton-Jones and Mr. Duthie, will visit British Guiana during the Easter vacation. They will leave by the s.s. *Stuyvesant* on the 25th March, and return by the s.s. *Van Rensselaer* on the 5th April. During the tour, which should be a most interesting one, they will visit different parts of British Guiana and have the opportunity of seeing the various activities of the British Guiana Department of Science and Agriculture. The tour should prove most instructive and the College is greatly indebted to the Director and Officers of the Department, for the facilities they will afford, and to the Government for their generous assistance, which will, in many ways, help to make the tour a success.

* * *

There have been many distinguished visitors to the College recently, amongst whom may be mentioned:—Field Marshal Lord Allenby and Lady Allenby; Admiral Sir Reginald Tupper; Mr. and Lady Dorothy D'Oyly Carte; Sir Algernon and Lady Aspinall; Sir Walter Roper Lawrence, Bart.; Mr. E. L. Hartley; Mr. C. Menier; Mr. J. H. Hannon, M.P., and Mrs. Hannon; Captain Reginald Jaffray of Bermuda; Dr. N. I. Vavilov, President of the Academy of Agricultural Sciences, Leningrad, U.S.S.R.; Mr. W. Pickard, a Director of Messrs. Cadbury Bros.; Mr. Mark Moody Stuart; Mr. E. M. Morcom, a Director of Messrs. Bellis & Morcom, Ltd.; Mr. F. A. Corea of St. Vincent; Sir Leonard Lyle, Bart., a Director of the Sugar Refining Firm of Messrs. Tate & Lyle, and Lady Lyle; Mr. and Mrs. G. Currie; Mr. F. Burnett, the Assistant Director of Agriculture, British Guiana; Mr. Ernest A. Savage, Principal Librarian to the Edinburgh Public Libraries, who visited the College on behalf of the Carnegie Corporation; Sir Emmanuel and Lady Hoyle; Mr. and Mrs. J. S. Hoyle; Mr. and Mrs. W. Dodd; Mr. J. Gordon-Miller; Sir Reginald Hoskins, who is Principal of the Bonar Law College, and Lady Hoskins; Mr. and Mrs. Aldous Huxley; Major and Mrs. W. H. C. Despard; Sir Thomas and Lady Taylor; Major Gerald Bell, of the Royal Empire Society; Major and Mrs. Previté; Lady Ian Malcolm; Sir Owen Seaman; the Rt. Hon. H. Spender Clay and Mrs. Clay; Major-General and Mrs. R. C. Collins; Lady Olivia Bentinck.

ASSOCIATESHIP AWARDS.

The following students have recently been awarded the Associateship:—

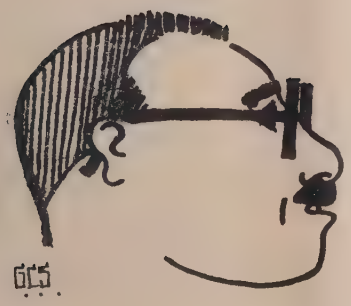
Mr. J. J. Anderson, B. Agric. (Belfast).
Mr. W. Beckett, M.A., Dip. Agric. (Cantab).
Mr. P. C. Chambers, B.A. (Cantab).
Mr. B. C. Charles, Dip. Agric. (Wye).
Mr. J. D. E. F. Vesey-Fitzgerald, B.Sc. Agric. (London.)
Mr. J. Gordon, B. Agric. (Belfast).
Mr. E. J. Gregory, Dip. Agric. (Wye).
Mr. J. R. E. Hindson, B.A., (Cantab).
Mr. A. Jones, B.Sc. (Bangor).
Mr. B. R. Jones, B.Sc. Agric. (London).
Mr. J. T. Moon, Dip. Agric. (Wye).
Mr. A. E. Moss, B.Sc. Agric. (London).
Mr. A. V. Richards, B.Sc. (London).
Mr. D. F. Ruston, N.D.A., B.Sc. Agric. (Leeds).
Mr. G. C. Stevenson, B.A. Hons. (Cantab).
Mr. F. B. Wilson, B.A. (Cantab).
Mr. N. Wright, B.Sc. (London).

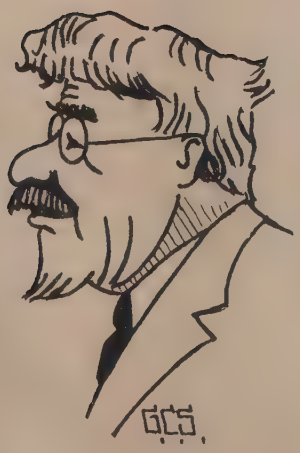
The following students have been awarded the Associateship in Sugar Technology:—

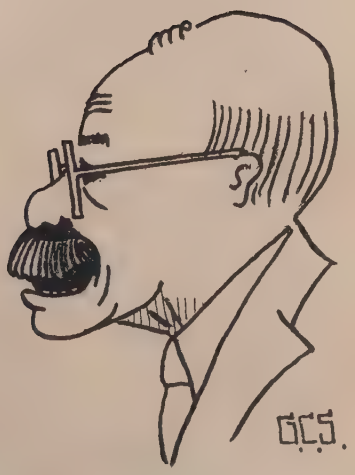
Mr. L. S. Birkett, Dip. Agric. (I.C.T.A).
Mr. J. de la Bastide, Dip. Agric. (I.C.T.A.)

We hope to announce the remaining awards in our next issue.

Will somebody explain the meaning of the following sentence spoken by a Pacific Island native.—"Take him this fellow basket along house belong Mary belong man belong Jesus; behind you bring him shootie-light belong me"?







COLLEGE CELEBRITIES

AGRICULTURAL EXCURSIONS.

THE first excursion of the term was to the cacao districts in the east of the Colony on 11th January. Much damage by thrips has been done this year and a visit was made to one or two estates which had suffered severely. The Government Experimental Station at Marper was inspected and the various experiments that are being carried out by the Department of Agriculture with a view to controlling and finding out more about "witchbroom" were explained by the staff of the Department. A discussion on the means of combating this baffling disease followed.

On 18th January the banana research work was explained, and the process of breeding and testing out new varieties and hybrids for resistance to Panama Disease was explained by Professor Cheesman and Dr. Wardlaw in the field, and by Dr. McGuire in the low temperature station. Particular interest was shown in the new Gros Michel × *M. malacaensis* hybrids and in the mutations that are arising from the Cavendish variety.

On the 25th a visit was made to Mr. W. S. E. Barnardo's grapefruit plantation at Spring Estate, Tamana. The system of cultivating, planting, fertilising and draining was explained, and a practical demonstration of inarching with sour orange against gummosis was given by Mr. Barnardo. Two days later the fruit picked on this estate was traced through the packing shed of the Co-Operative Citrus Growers' Association at Laventille, and the method of washing, packing and grading the fruit for export was seen.

Field demonstrations were held on the College Farm on 1st February and 8th March. On the former occasion a very interesting practical demonstration of various tillage implements was staged, and on the latter, the various experimental and demonstration plots were discussed and inspected. The party on this occasion had the unique experience of being filmed for an Empire Marketing Board picture.

Excursions designed to give practical demonstrations of tropical hygiene and sanitation methods were held on 8th and 15th February. On the latter occasion Orange Grove Estate was visited and the barracks and general sanitary arrangements were explained by Dr. Dickson. Through the courtesy of Mr. J. H. Taylor, an opportunity was also afforded of seeing the Orange Grove Sugar Factory.

Coconuts were the main object of the field day on 22nd February. A visit was made to the Perseverance Estate at Waterloo and the method of harvesting nuts and of extracting copra observed. The practice of picking nuts on this estate has now been abandoned and dropped ripe nuts only are collected. The drying of the copra in "chulas" by artificial heat was next observed at Exchange, and finally the method of preparing edible oil, lard substitute and soap from the copra was shown by Captain W. F. Watson, the General Manager of Waterloo Estates who conducted the party over the new oil and soap factory. During this visit which took the whole day, the model dairy herd of Friesian and grade Friesian cattle was inspected and the sugar factory visited.

The Cotton Research Station at St. Augustine was visited on 1st March, and an interesting morning was spent with Dr. S. C. Harland and Mr. J. B. Hutchinson who exhibited their very complete collection of wild and cultivated cottons. Problems of higher genetics as applied to cotton were discussed and the attempts that are now being made to apply the scientific results so far obtained to practical cotton-breeding problems were noted with great interest.

SPORTS.

The Rugby XV, by securing two further victories, the first against an All-Trinidad XV, and the second against the Navy, remain unbeaten for the season. It is rumoured that a match may be played against British Guiana during the forthcoming tour. If this should take place the College will have to field a weakened side as they will be without Campbell, Buckley and Garcez. Whatever happens, good luck to them!

* * *

The last matches of the Tennis League competition were played in December and January when the College team beat the St. Augustine, Portuguese, Queen's Park and Marine Square Clubs, and lost to Tranquillity Square. The team seemed to have at last found its form and it was a pity it did not do better in the earlier stages of the competition. The number of points scored in the last matches played did not, unfortunately, alter the position of the team in the League table, fifth place being secured out of seven competing Clubs.

Great interest is being shown in the College Singles' Handicap Tournament. There are in all fifty-four entrants which must surely be a record.

* * *

The annual Cricket match between the Staff and Students took place on Sunday, 12th February. The 'other story', as was predicted in our last issue, has now to be told. In short, the Staff, fielding a side of seventeen strong, were well beaten. It must be recorded, however, that the Staff's score topped all those made in previous historic encounters. The students won their match with a mere handful of batsmen, most of whom retired 'not out.' What a downfall to the Staff's bowling which showed such wonderful promise last year. Even Corbin's terrific deliveries were of no avail.

At home the Diploma students have challenged the Post Graduates and beaten them at Tennis and Cricket. The Post Graduates, on the other hand, won the Soccer match. These fixtures have been greatly enjoyed and it is hoped that they will be renewed next year.

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The Hockey XI shows promise of developing into a really good side and has won several matches already.

* * *

The Water Polo team has played a number of matches, most of which were with the Navy.

OLD STUDENTS' CORNER.

B. C. G. Charles (1931-32) has been appointed Agricultural Officer, Nyasaland.

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F. B. Wilson (1931-32) has been appointed Agricultural Officer, Zanzibar.

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P. C. Chambers (1931-32) has been appointed Agricultural Officer, Kenya.

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J. T. H. Stein (1931-32) has been posted to Dunkwa (Gold Coast).

* * *

J. L. Scott (1929-30) has been transferred to Kpeve (Gold Coast) where he will take charge of the Trans-Volta district.

* * *

H. D. Huggins (1924-26) a member of the Staff of the Department of Science and Agriculture, British Guiana, is at present taking a refresher course in Agricultural Economics at Cornell University, Ithaca, New York.

J. L. Grogan (1927-30) has been appointed Chemist in Charge, Lemon Arbour Factory, Barbados.

* * *

J. M. Ward (1928-29) has been posted to Head Office, Accra (Gold Coast), as Accountant and Office Superintendent.

* * *

G. C. Stevenson (1931-32) has been appointed Assistant Botanist to the Central Cane Breeding Station, Barbados.

* * *

B. R. Jones (1931-32) and D. F. Ruston 1931-32) have obtained appointments with the United Fruit Company, and are at present stationed in Jamaica.

* * *

W. H. Beckett (1930-31) and T. L. Williams (1926-27), Gold Coast Agricultural Service, proceeded on leave on March 5th and 14th, respectively.

* * *

H. K. Hewison (1926-27) has, owing to ill-health, retired from the Gold Coast Agricultural Service. Hewison joined this Service in 1921. After being stationed in Ashanti, he was transferred in 1928 to Togoland as Officer in Charge of the Kpeve Experiment Station.

* * *

J. Robertson (1928-29) is stationed at Morogoro, Tanganyika Territory, where he is in charge of the Agricultural Station. After returning from leave last year he spent two months at Barberton. His work is chiefly in connection with cotton, a crop which is being grown successfully in his District.

* * *

G. W. Lock (1930-31) has been transferred from Tanga, where he had been working for seven months with J. E. Bruce (1927-28), to Lushoto, a hill station in Tanganyika. For the past year most of his time was spent in trying to increase native production of economic crops on the one hand and combating locusts on the other. The latter have, apparently, been a terrible scourge, especially in Kenya. He describes the Tanga area as a well developed fertile corner of a rather arid territory. There is a large variety of crops, including cacao. Lushoto is 5000 feet up in the hills and was somewhat of a change after the Coast. Lock expects to be on leave next summer. Most officials, he says, are now doing 30 to 34 months tours. He finds his work very interesting, the climate healthy, and sounds very happy in his surroundings.

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better purging massecuite at high Brix can be obtained with a corresponding increase in the centrifugal capacity ; and lastly there is a striking reduction of time in process, since a final product can be obtained within 15 to 18 hours, as compared with 5 to 6 days in the ordinary crystallizers.—(*Inter. Sugar Journ.* Vol. XXXV, No. 410, February, 1933, pp. 82-83.)

CHEMICAL NOTES.

Compiled by the College Department of Chemistry and Soil Science.

The Effect of Manurial Treatment on Sugar-Cane Juice.

In the Annual Report of the Director of Research of the Philippine Sugar Association for the year 1930-31, Dr. Alicante, the chemist in charge, describes some interesting results that have considerable bearing on the important question of the effect of manures on the quality of sugar-cane juice. It has long been believed that juice quality, and also sucrose content per unit weight of juice and of cane, depend partly on nutrition, and often therefore on manurial treatment. Thus in the Philippines, Hawaii, and Java, cane agriculturists have claimed that nitrogenous manures and phosphatic manures, although they stimulate vegetative growth, seriously reduce the yield of sugar per ton of cane. The effect of potassic manures, in many cases, is apparently different. Other essential mineral components of plants may perhaps also favourably influence juice quality. The effect of these minor elements has been investigated in the Philippines by analysing the ash of bagasse, and by studying the results of such analyses in their relation to sugar yields. It is conceivable that certain natural mineral components, other than nitrogen, phosphorus, and potassium, may exert a catalytic influence on the formation of sucrose from hexoses within the cane stem.

The case of *calcium* deserves first consideration. Whilst sugar-canes grown on limestone soils are generally believed to yield juices of higher purity and sucrose content than canes grown, say, on acidic volcanic soils, applications of lime to soils in the Philippines have often failed to improve juice quality and yields of sugar per ton of cane. There may be, however, some factor other than lime that improves the juice of canes grown in limestone districts. Chemical analyses of bagasse ash have shown that the uptake of lime from the soil is very uniform, regardless of the lime content of the soil, so that one is forced to the conclusion that the observed benefits of lime are solely due to its effects on the physical properties of the soil, and not directly to its function as a plant nutrient.

The case of *magnesium* is somewhat similar. Ash analysis of bagasse in the Philippines has shown that its content of magnesia is also remarkably uniform, but that there is no constant ratio between lime content and magnesia content, though the latter is generally the smaller. Whilst magnesium is an essential component of chlorophyll, and might therefore be thought to influence the photosynthesis of sugars in the cane, no correlation could be found between magnesia contents and yields of sugar per ton of cane.

The case of *manganese* is much more suggestive. Analyses here have indicated that canes grown on Philippine limestone soils, and exhibiting desirable juice qualities and high yields of sugar per ton of cane, contain higher amounts of manganese in the bagasse-ash than canes grown on other soils under similar climatic conditions, but containing juice of poorer qualities. Although the point is not yet proved, the subject deserves further study, and investigations on the role of manganese are being continued.

* * *

An Improved Type of Artificial Silk.

Synthetic fibres have been produced, with chemical and physical properties closely resembling those of natural silk, from solutions containing cellulose acetate and a protein such as gelatin or casein in 98 to 99 per cent. formaldehyde, the protein content varying from 15 to 25 per cent. Alternatively, a solution of casein in formaldehyde may be added to cellulose acetate dissolved in acetone containing methyl alcohol. The mixed solutions remain homogeneous during evaporation of the solvent. Cellulose acetate films containing 15 per cent. of casein were found to be equal to pure cellulose acetate films in tensile properties, but the dyeing properties of the mixed rayon differed from those of pure cellulose acetate and resembled natural silk. Of the proteins examined, casein gave the most satisfactory products. (Loiseleur and Velluz ; *Chim. et Ind.*, 1932, Vol. XXVIII, p. 538. *Brit. Chem. Abstr.* B. January 6th., 1933, p. 13.)

* * *

Soap and Oil Industries in India.

South India enjoys an abundant supply of materials for making soap, but the utility of some of these was not generally understood until the Government Soap Institute at Calicut showed how various vegetable oils could be profitably employed. This Institute was started at Tanur, seventeen years ago by Sir Frederick Nicholson, as a branch of the Fisheries Station, and the field of research was gradulaly extended to include work on lubricating oils and paints as well as on the deodorization and hydrogenation of oils. India exports over a million tons of oil seeds annually, and a large part of the oil extracted return in the form of fats or refined oils. The Soap Institute at Calicut is devising methods which may be employed by peasants and the industrialists for the extraction and utilization of these oils. (*Chem. & Ind.*, Vol. LI, 1932, p. 1038.)

TREND OF THE MARKETS.

[*The notes below are based principally upon running charts of the prices of the basic grades and upon general statistical information gleaned from contemporary publications and cablegrams and are intended to be a record of movements. An attempt is made, where possible, to indicate the market outlook at the time of going to press, but no responsibility for the accuracy and subsequent truth of such observations is assumed. Unless otherwise stated the prices quoted are spot, London.*]

SUGAR.—Prices on the Home Market have ranged as follows (c.i.f. per cwt.) :—

	Foreign.	*Preferential.*
	s. d.	*s. d.*
26th Jan. ..	4 10½	9 9
2nd Feb. ..	4 9¾	9 7½
9th Feb. ..	5 1½	9 10½
16th Feb. ..	5 6	10 3¾
23rd Feb. ..	5 6	10 3
2nd Mar. ..	5 9¼	10 5¼
9th Mar. ..	5 9¾	10 7½
(10*th Mar.*, 1932) ..	5 4½	9 1½

Better prices have on the whole ruled for the article since our last report. This has mainly been due to the development of a heavy demand for White sugars from distributors who had allowed their Refined stocks to dwindle to a very low level. In the United Kingdom considerable business has been done in both Raws and White sugars, whilst in America an increased volume of Raw sales has been transacted. The trend of the market has been further encouraged by reports that negotiations were proceeding between the British Refining and Beet Sugar Industries on questions of common interest amongst which was the better regulation of sugar distribution. It is probable that the present banking crisis in America will be regarded as a bearish factor but the sugar market has shown once again its sensitiveness to any increased activity from the buying section of the Trade.

* * *

COCOA.—Prices are very weak owing to the dislocation of business caused by the financial crisis in the U.S.A., the principal consumer of cocoa beans. Nominal prices for various grades are as follows :—Accra at 24s. to 25*s.* ; Cameroon at 26*s.* to 28*s.* ; Venezuelan unclayed at 65*s.* to 100*s.*, clayed at 65*s.* to 95*s.* Futures have not been active and prices have given way 6*d.* to 10½*d.* In Trinidad $5.00 to $5.50 a fanega is being paid. (*By courtesy of the Cocoa Planters' Association of Trinidad, Limited.*)

* * *

GRAPEFRUIT.—The market is rather weak owing to an increase in supplies. The average prices ruling in Covent Garden last week-end for popular sizes, best quality, 80's-126's were:

	s. d.		*s. d.*
Trinidad	16 0	to	18 0
Jamaica	12 0	to	14 0
Florida	14 0	to	16 0
Jaffa	13 0	to	15 0

(*West India Committee Circular*, 16th February.)

COTTON.—The following are the official spot prices in pence per lb. of the Liverpool Cotton Association :—

	American Mid.	*Egyptian F.G.F. Sakel.*
27th Jan. ..	5.15	7.18
3rd Feb. ..	4.94	7.14
10th Feb. ..	5.09	7.29
17th Feb. ..	4.95	7.03
24th Feb. ..	4.95	—
3rd Mar. ..	4.79	—
10th Mar. ..	5.17	—
(11*th Mar.*, 1932) ..	5.51	7.40

The market for American, after a little advance, at the beginning of February, appears to be settling back into its old rut and narrow range of fluctuation. According to the *West India Committee Circular* for February 16th, business in West Indian Sea Island has been confined to about 50 bales of stained and tinged cotton at 4*d.* to 8*d.*, and about 20 bales of Barbados at 13*d.* White cotton continues generally neglected.

* * *

COPRA.—Copra is a firmer market and there are now buyers of West Indian f.m.s. at £13 10*s.* c.i.f. for April-May.—(*West India Committee Circular*, 16th February.)

* * *

BANANAS.—The demand continues poor and the wholesale price of Jamaicas has been reduced a further £1 10*s.* per ton to £18 5*s.* delivered London, and £18 nearest railway station. Brazilians are unchanged at £18 per ton nearest station. — (*West India Committee Circular*, February 16th).

* * *

COFFEE.—Up to the middle of February, sales have generally been good all round, Costa Rica's finest pea-berry fetching 137*s.* per cwt., and Kenya 56*s.* to 126*s.*

* * *

TEA.—According to the *Times Trade & Engineering Supplement* for February 18th, latest averages include Ceylon at 13.42*d.*, which is the best average for some time and well above the 11.74*d.* of Mid February, 1932 ; Indian at 9.80*d.* ; Java at 6.69*d.* Average prices for all sorts have risen steadily since the middle of January.

* * *

RUBBER.—Quotations for Plantation have ranged as follows :—

	d.
25th Jan.	2 7/32
1st Feb.	2 1/16
8th Feb.	2 3/32
15th Feb.	2 3/32
22nd Feb.	2 3/32
1st Mar.	2 1/32
8th Mar.	2⅛
(9*th Mar.*, 1932)	2¼

Slight advances have been recorded recently but the market, as a whole, remains steady.